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Langley Research Center

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- Domestic and foreign dissertations and theses

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The Federal Depository Library Program (FDLP)

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

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

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Subject Term Index

Personal Author Index

SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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01
AERONAUTICS (GENERAL)

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

20040105522 NASA Langley Research Center, Hampton, VA, USA
Low-Density Aerodynamics of the Stardust Sample Return Capsule
Wilmoth, Richard G.; Mitcheltree, Robert A.; Moss, James N.; [1997]; 9 pp.; In English
Report No.(s): AIAA Paper 97-2510; Copyright; Avail: CASI; A02, Hardcopy

The aerodynamics of the Stardust Sample Return Capsule are analyzed in the low- density, transitional flow regime using free-molecular, Direct Simulation Monte Carlo, Navier-Stokes, and Newtonian methods to provide inputs for constructing a transitional flow bridging relation. The accuracy of this bridging relation in reconstructing the aero- dynamic coefficients given by the more exact methods is presented for a range of flight conditions and vehicle attitudes. There is good agreement between the various prediction methods, and a simple sine-squared bridging relation is shown to provide a reasonably good description of the axial force, normal force, and pitching moment over a range of Knudsen numbers from 0.001 to 10. The predictions show a static instability of the Star- dust capsule in the free-molecular regime that persists well into the transitional flow. The addition of a thin disk to the base of the capsule is shown to remove this static instability. However, the extremely high entry velocity of 12.6 km/s for the proposed trajectory introduces difficult design issues for incorporating this disk caused by the high aerothermal loads that occur even under relatively rarefied conditions.
Author
Low Density Flow; Aerodynamic Loads; Stardust Mission; Sample Return Missions

20040110408 NASA Langley Research Center, Hampton, VA, USA
Advanced Civilian Aeronautical Concepts
Bushnell, Dennis M.; [1996]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Paper discusses alternatives to currently deployed systems which could provide revolutionary improvements in metrics applicable to civilian aeronautics. Specific missions addressed include subsonic transports, supersonic transports and personal aircraft. These alternative systems and concepts are enabled by recent and envisaged advancements in electronics, communications, computing and Designer Fluid Mechanics in conjunction with a design approach employing extensive synergistic interactions between propulsion, aerodynamics and structures.
Author
Aeronautical Engineering; Civil Aviation; Computational Fluid Dynamics; Aerodynamic Configurations

20040110425 NASA Langley Research Center, Hampton, VA, USA
Airborne Systems Technology Application to the Windshear Threat
Arbuckle, P. Douglas; Lewis, Michael S.; Hinton, David A.; [1996]; 12 pp.; In English; 20th Congress International Council of the Aeronautical Sciences, 8-13 Sep. 1996, Sorrento, Italy
Report No.(s): ICAS Paper 96-5.7.1; No Copyright; Avail: CASI; A03, Hardcopy

The general approach and products of the NASA/FAA Airborne Windshear Program conducted by NASA Langley Research Center are summarized, with references provided for the major technical contributions. During this period, NASA conducted 2 years of flight testing to characterize forward-looking sensor performance. The NASA/FAA Airborne Windshear Program was divided into three main elements: Hazard Characterization, Sensor Technology, and Flight Management Systems. Simulation models developed under the Hazard Characterization element are correlated with flight test data. Flight

test results comparing the performance and characteristics of the various Sensor Technologies (microwave radar, lidar, and infrared) are presented. Most of the activities in the Flight Management Systems element were conducted in simulation. Simulation results from a study evaluating windshear crew procedures and displays for forward-looking sensor-equipped airplanes are discussed. NASA Langley researchers participated heavily in the FAA process of generating certification guidelines for predictive windshear detection systems. NASA participants felt that more valuable technology products were generated by the program because of this interaction. NASA involvement in the process and the resulting impact on products and technology transfer are discussed in this paper.
Author
Wind Shear; Flight Tests; Technology Transfer; Meteorological Radar; Airborne Surveillance Radar; NASA Programs

20040110733 Stirling Dynamics, Inc., Kirkland, WA, USA
Documentation of the Linear Statistical Discrete Gust Method
Jones, J. G.; Jul. 2004; In English
Report No.(s): PB2004-106670; No Copyright; Avail: National Technical Information Service (NTIS)

The Statistical Discrete Gust (SDG) method is an alternate procedure for estimating and predicting severe gust and severe turbulence loads. This method claims to have the potential to replace the combined Power Spectral Density (PSD) Model of Title 14 Code of Federal Regulations (CFR) 25.341(b) and the Tuned Isolated Discrete Gust (IDG) of 14 CFR 25.341(a), which jointly ensures that an airplane has sufficient structural strength for encounters with continuous turbulence (PSD) and discrete gusts (TDG) of design-level intensity. The SDG method provides such a specification in a form that takes into account the non-Gaussian statistical structure of the more intense turbulence fluctuations and the manner in which these interact with the dynamic response of a flexible aircraft. This report documents the development of the method, as applied to the response of a linear aircraft, in the following order: historical development, evidence that severe and extreme gust encounters are characterized by short-duration bursts evidence for the 1/6 scaling law examples of calculated loads and comparisons with models in existing requirements, and advantages and limitations of current SDG models. The SDG method was developed over a period of over 30 years, and during its development, many in industry, research institutions, and academia have expressed divergent viewpoints regarding the suitability of using the SDG method for the derivation of design gust loads. Consequently, the Federal Aviation Administration has invited three experts to express their views and comments, which have been included as an addendum in the documentation of the SDG method contained herein.
NTIS
Turbulence; Gust Loads; Predictions

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*.

20040095911 NASA Dryden Flight Research Center, Edwards, CA, USA
Real-Time Unsteady Loads Measurements Using Hot-Film Sensors
Mangalam, Arun S.; Moes, Timothy R.; [2004]; 21 pp.; In English; AIAA Applied Aerodynamics Conference and Exhibit, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 090-50-00-SE-RR
Report No.(s): NASA/TM-2004-212854; H-2568; No Copyright; Avail: CASI; A03, Hardcopy

Several flight-critical aerodynamic problems such as buffet, flutter, stall, and wing rock are strongly affected or caused by abrupt changes in unsteady aerodynamic loads and moments. Advanced sensing and flow diagnostic techniques have made possible simultaneous identification and tracking, in realtime, of the critical surface, viscosity-related aerodynamic phenomena under both steady and unsteady flight conditions. The wind tunnel study reported here correlates surface hot-film measurements of leading edge stagnation point and separation point, with unsteady aerodynamic loads on a NACA 0015 airfoil. Lift predicted from the correlation model matches lift obtained from pressure sensors for an airfoil undergoing harmonic pitchup and pitchdown motions. An analytical model was developed that demonstrates expected stall trends for pitchup and pitchdown motions. This report demonstrates an ability to obtain unsteady aerodynamic loads in real time, which

could lead to advances in air vehicle safety, performance, ride-quality, control, and health management.
Author
Aerodynamic Loads; Unsteady Aerodynamics; Stagnation Point; Buffeting; Wing Rock; Flutter; Flight Conditions

20040095946 NASA Langley Research Center, Hampton, VA, USA
Wind Tunnel Test of an RPV with Shape-Change Control Effector and Sensor Arrays
Raney, David L.; Cabell, Randolph H.; Sloan, Adam R.; Barnwell, William G.; Lion, S. Todd; Hautamaki, Bret A.; [2004]; 12 pp.; In English; AIAA Guidance, Navigation and Control Conference, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 23-762-55-MS
Report No.(s): AIAA Paper 2004-5114; No Copyright; Avail: CASI; A03, Hardcopy

A variety of novel control effector concepts have recently emerged that may enable new approaches to flight control. In particular, the potential exists to shift the composition of the typical aircraft control effector suite from a small number of high authority, specialized devices (rudder, aileron, elevator, flaps), toward larger numbers of smaller, less specialized, distributed device arrays. The concept envisions effector and sensor networks composed of relatively small high-bandwidth devices able to simultaneously perform a variety of control functions using feedback from disparate data sources. To investigate this concept, a remotely piloted flight vehicle has been equipped with an array of 24 trailing edge shape-change effectors and associated pressure measurements. The vehicle, called the Multifunctional Effector and Sensor Array (MESA) testbed, was recently tested in NASA Langley's 12-ft Low Speed wind tunnel to characterize its stability properties, control authorities, and distributed pressure sensitivities for use in a dynamic simulation prior to flight testing. Another objective was to implement and evaluate a scheme for actively controlling the spanwise pressure distribution using the shape-change array. This report describes the MESA testbed, design of the pressure distribution controller, and results of the wind tunnel test.
Author
Wind Tunnel Tests; Remotely Piloted Vehicles; Control Surfaces; Shape Control; Flight Control

20040095949 NASA Langley Research Center, Hampton, VA, USA
Rarefied Aerothermodynamic Predictions for Mars Global Surveyor
Wilmoth, R. G.; Rault, D. F. G.; Shane, R. W.; Tolson, R. H.; [1998]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Mars Global Surveyor (MGS) successfully completed its first phase of aerobraking in early 1998 and is the rst planetary mission to use aerobraking as a primary means of customizing its orbit to achieve its mission objectives. The aerobraking requirements together with post-launch anomalies presented a unique challenge to provide accurate predictions of the aerothermodynamic environment of the spacecraft in the rare transitional flow regime. Direct Simulation Monte Carlo (DSMC) and free molecular techniques were used to provide heating and aerodynamic predictions and to investigate a variety of rarefied flow phenomena across the regime; MGS is the first major planetary mission in which rare flow predictions have played such a critical role all the way through design, mission planning, and operational phases. This paper summarizes these studies with emphasis on transitional-flow and gas-surface interaction phenomena.
Author
Aerothermodynamics; Mars Global Surveyor; Rarefied Gas Dynamics; Spacecraft Configurations

20040100700 NASA Langley Research Center, Hampton, VA, USA
Aerothermal Test of Metallic TPS for X-33 Reusable Launch Vehicle
Sawyer, James Wayne; Hodge, Jefferson; Moore, Brad; [1998]; 7 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

An array of metallic Thermal Protection System (TPS) panels including the seals developed for the windward surface of the X-33 vehicle is being tested in the Eight Foot High Temperature Tunnel at the NASA Langley Research Center. These tests are the first aerothermal tests of an X-33 TPS array and will be used to validate the TPS for the X-33 flight program. Specifically, the tests will be used to evaluate the structural and thermal performance of the TPS, the effectiveness of the high temperature seals between adjacent tiles and the durability of the TPS under realistic aerothermal flight conditions. The effect of varying step heights, damage to the seals between adjacent panels, and the use of secondary seals will also be investigated during the test program. The metallic TPS developed for the windward surface of the X-33 and the test program in the Eight Foot High Temperature Tunnel is presented and discussed.
Author
Aerothermodynamics; Thermal Protection; X-33 Reusable Launch Vehicle; Metals; Fabrication; Blowdown Wind Tunnels

20040100834 Iowa State Univ. of Science and Technology, Ames, IA, USA
Numerical Simulation of Supersonic MHD Flows using an Iterative PNS Algorithm
Mehta, Unmeel B., Technical Monitor; Tannehill, J. C.; [2004]; 43 pp.; In English
Contract(s)/Grant(s): NCC2-5517; No Copyright; Avail: CASI; A03, Hardcopy

This final report summarizes the research accomplished under NASA-Ames Cooperative Agreement NCC2-5517 during the period which extended from August 1, 2002 to July 31,2004.
Derived from text
Magnetohydrodynamic Flow; Supersonic Flow; Magnetohydrodynamics; Simulation

20040105536 NASA Langley Research Center, Hampton, VA, USA
Prediction of High-Lift Flows using Turbulent Closure Models
Rumsey, Christopher L.; Gatski, Thomas B.; Ying, Susan X.; Bertelrud, Arild; [1997]; 15 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The flow over two different multi-element airfoil configurations is computed using linear eddy viscosity turbulence models and a nonlinear explicit algebraic stress model. A subset of recently-measured transition locations using hot film on a McDonnell Douglas configuration is presented, and the effect of transition location on the computed solutions is explored. Deficiencies in wake profile computations are found to be attributable in large part to poor boundary layer prediction on the generating element, and not necessarily inadequate turbulence modeling in the wake. Using measured transition locations for the main element improves the prediction of its boundary layer thickness, skin friction, and wake profile shape. However, using measured transition locations on the slat still yields poor slat wake predictions. The computation of the slat flow field represents a key roadblock to successful predictions of multi-element flows. In general, the nonlinear explicit algebraic stress turbulence model gives very similar results to the linear eddy viscosity models.
Author
Airfoils; Eddy Viscosity; Stress Analysis; Turbulence Models; Flow Distribution

20040105538 NASA Langley Research Center, Hampton, VA, USA
Aerodynamics of Stardust Sample Return Capsule
Mitcheltree, R. A.; Wilmoth, R. G.; Cheatwood, F. M.; Brauckmann, G. J.; Greene, F. A.; [1997]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Successful return of interstellar dust and cometary material by the Stardust Sample Return Capsule requires an accurate description of the Earth entry vehicle's aerodynamics. This description must span the hypersonic-rarefied, hypersonic-continuum, supersonic, transonic, and subsonic flow regimes. Data from numerous sources are compiled to accomplish this objective. These include Direct Simulation Monte Carlo analyses, thermochemical nonequilibrium computational fluid dynamics, transonic computational fluid dynamics, existing wind tunnel data, and new wind tunnel data. Four observations are highlighted: 1) a static instability is revealed in the free-molecular and early transitional-flow regime due to aft location of the vehicle s center-of-gravity, 2) the aerodynamics across the hypersonic regime are compared with the Newtonian flow approximation and a correlation between the accuracy of the Newtonian flow assumption and the sonic line position is noted, 3) the primary effect of shape change due to ablation is shown to be a reduction in drag, and 4) a subsonic dynamic instability is revealed which will necessitate either a change in the vehicle s center-of-gravity location or the use of a stabilizing drogue parachute.
Author
Cosmic Dust; Interstellar Matter; Aerodynamics; Atmospheric Entry; Aerospace Vehicles; Supersonic Flow; Transonic Flow

20040105541 NASA Ames Research Center, Moffett Field, CA, USA
Computational Aerothermodynamic Design Issues for Hypersonic Vehicles
Olynick, David R.; Venkatapathy, Ethiraj; [2004]; 35 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

A brief review of the evolutionary progress in computational aerothermodynamics is presented. The current status of computational aerothermodynamics is then discussed, with emphasis on its capabilities and limitations for contributions to the design process of hypersonic vehicles. Some topics to be highlighted include: (1) aerodynamic coefficient predictions with emphasis on high temperature gas effects; (2) surface heating and temperature predictions for thermal protection system (TPS) design in a high temperature, thermochemical nonequilibrium environment; (3) methods for extracting and extending computational fluid dynamic (CFD) solutions for efficient utilization by all members of a multidisciplinary design team; (4) physical models; (5) validation process and error estimation; and (6) gridding and solution generation strategies. Recent

experiences in the design of X-33 will be featured. Computational aerothermodynamic contributions to Mars Pathfinder, METEOR, and Stardust (Comet Sample return) will also provide context for this discussion. Some of the barriers that currently limit computational aerothermodynamics to a predominantly reactive mode in the design process will also be discussed, with the goal of providing focus for future research.
Author
Aerothermodynamics; Computational Fluid Dynamics; Hypersonic Vehicles; Aerodynamic Coefficients; Heating

20040105562 NASA Ames Research Center, Moffett Field, CA, USA
Overview of X-38 Hypersonic Aerothermodynamic Wind Tunnel Data and Comparison with Numerical Results
Campbell, C.; Caram, J.; Berry, S.; Horvath, T.; Merski, N.; Loomis, M.; Venkatapathy, E.; [2004]; 11 pp.; In English; 32nd AIAA Thermophysics Conference, 23-25 Jun. 1997, Atlanta, GA, USA
Contract(s)/Grant(s): NAS2-14031
Report No.(s): AIAA Paper 97-2475; Copyright; Avail: CASI; A03, Hardcopy

A NASA team of engineers has been organized to design a crew return vehicle for returning International Space Station crew members from orbit. The hypersonic aerothermodynamic characteristics of the X-23/X-24A derived X-38 crew return vehicle are being evaluated in various wind tunnels in support of this effort. Aerothermodynamic data from two NASA hypersonic tunnels at Mach 6 and Mach 10 has been obtained with cast ceramic models and a thermographic phosphorus digital imaging system. General windward surface heating features are described based on experimental surface heating images and surface oil flow patterns for the nominal hypersonic aerodynamic orientation. Body flap reattachment heating levels are examined. Computational Fluid Dynamics tools have been applied at the appropriate wind tunnel conditions to make comparisons with this data.
Author
Aerothermodynamics; X-38 Crew Return Vehicle; Spacecrews; Computational Fluid Dynamics

20040105590 NASA Ames Research Center, Moffett Field, CA, USA
Aeroheating and Aerodynamic CFD Validation And Prediction for The X-38 Program
Loomis, Mark P.; Venkatapathy, Ethiraj; Papadopoulos, Periklis; Davies, Carol B.; Berry, Scott; Horvath, Tom; Campbell, Charles; [2004]; 12 pp.; In English; 32nd Thermophysics Conference, 23-25 Jun. 1997, Atlanta, GA, USA
Contract(s)/Grant(s): NAS2-14031
Report No.(s): AIAA- Paper 2478; Copyright; Avail: CASI; A03, Hardcopy

This paper presents the results of a computational fluid dynamics validation exercise using the General Aerodynamic Simulation Program (GASP) code for vehicles under consideration for the X-38 program. The scope of the exercise involved simulation and comparison with wind tunnel aeroheating and aerodynamic data in the hypersonic regime. In addition, simulations were performed and results are presented for the full-scale flight vehicle along an expected re- entry trajectory.
Author
Aerodynamic Heating; Computational Fluid Dynamics; X-38 Crew Return Vehicle

20040110284 NASA Langley Research Center, Hampton, VA, USA
Aeroelastic Deflection of NURBS Geometry
Samareh, Jamshid A.; [1998]; 11 pp.; In English; 6th International Conference on Numerical Grid Generation in Computational Field Simulation, 6-9 Jul. Jul. 1998, London, UK; No Copyright; Avail: CASI; A03, Hardcopy

The purpose of this paper is to present an algorithm for using NonUniform Rational B-Spline (NURBS) representation in an aeroelastic loop. The algorithm is based on creating a least-squares NURBS surface representing the aeroelastic defection. The resulting NURBS surfaces are used to update either the original Computer- Aided Design (CAD) model, Computational Structural Mechanics (CSM) grid or the Computational Fluid Dynamics (CFD) grid. Results are presented for a generic High-Speed Civil Transport (HSCT).
Author
Algorithms; Aeroelasticity; Computational Fluid Dynamics; Computer Aided Design

20040110310 NASA Langley Research Center, Hampton, VA, USA
Global Nonlinear Parametric Modeling with Application to F-16 Aerodynamics
Morelli, Eugene A.; [1997]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A global nonlinear parametric modeling technique is described and demonstrated. The technique uses multivariate

orthogonal modeling functions generated from the data to determine nonlinear model structure, then expands each retained modeling function into an ordinary multivariate polynomial. The final model form is a finite multivariate power series expansion for the dependent variable in terms of the independent variables. Partial derivatives of the identified models can be used to assemble globally valid linear parameter varying models. The technique is demonstrated by identifying global nonlinear parametric models for nondimensional aerodynamic force and moment coefficients from a subsonic wind tunnel database for the F-16 fighter aircraft. Results show less than 10% difference between wind tunnel aerodynamic data and the nonlinear parameterized model for a simulated doublet maneuver at moderate angle of attack. Analysis indicated that the global nonlinear parametric models adequately captured the multivariate nonlinear aerodynamic functional dependence.
Author
Aerodynamics; F-16 Aircraft; Nonlinearity; Independent Variables; Multivariate Statistical Analysis

20040110670 NASA Langley Research Center, Hampton, VA, USA
Videometric Applications in Wind Tunnels
Burner, A. W.; Radeztsky, R. H.; Liu, Tian-Shu; [1997]; 14 pp.; In English
Contract(s)/Grant(s): NASA-WTD-10197; No Copyright; Avail: CASI; A03, Hardcopy

Videometric measurements in wind tunnels can be very challenging due to the limited optical access, model dynamics, optical path variability during testing, large range of temperature and pressure, hostile environment, and the requirements for high productivity and large amounts of data on a daily basis. Other complications for wind tunnel testing include the model support mechanism and stringent surface finish requirements for the models in order to maintain aerodynamic fidelity. For these reasons nontraditional photogrammetric techniques and procedures sometimes must be employed. In this paper several such applications are discussed for wind tunnels which include test conditions with Mach number from low speed to hypersonic, pressures from less than an atmosphere to nearly seven atmospheres, and temperatures from cryogenic to above room temperature. Several of the wind tunnel facilities are continuous flow while one is a short duration blowdown facility. Videometric techniques and calibration procedures developed to measure angle of attack, the change in wing twist and bending induced by aerodynamic load, and the effects of varying model injection rates are described. Some advantages and disadvantages of these techniques are given and comparisons are made with non-optical and more traditional video photogrammetric techniques.
Author
Wind Tunnels; Angle of Attack; Displacement Measurement; Photogrammetry; Deformation; Bending; Aerodynamic Loads

20040110755 NASA Langley Research Center, Hampton, VA, USA
Progressive Aerodynamic Model Identification From Dynamic Water Tunnel Test of the F-16XL Aircraft
Murphy, Patrick C.; Klein, Vladislav; Szyba, Nathan M.; [2004]; 20 pp.; In English; AIAA Atmospheric Flight Mechanics Conference, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 762-45-DB
Report No.(s): AIAA Paper 2004-5277; No Copyright; Avail: CASI; A03, Hardcopy

Development of a general aerodynamic model that is adequate for predicting the forces and moments in the nonlinear and unsteady portions of the flight envelope has not been accomplished to a satisfactory degree. Predicting aerodynamic response during arbitrary motion of an aircraft over the complete flight envelope requires further development of the mathematical model and the associated methods for ground-based testing in order to allow identification of the model. In this study, a general nonlinear unsteady aerodynamic model is presented, followed by a summary of a linear modeling methodology that includes test and identification methods, and then a progressive series of steps suggesting a roadmap to develop a general nonlinear methodology that defines modeling, testing, and identification methods. Initial steps of the general methodology were applied to static and oscillatory test data to identify rolling-moment coefficient. Static measurements uncovered complicated dependencies of the aerodynamic coefficient on angle of attack and sideslip in the stall region making it difficult to find a simple analytical expression for the measurement data. In order to assess the effect of sideslip on the damping and unsteady terms, oscillatory tests in roll were conducted at different values of an initial offset in sideslip. Candidate runs for analyses were selected where higher order harmonics were required for the model and where in-phase and out-of-phase components varied with frequency. From these results it was found that only data in the angle-of-attack range of 35 degrees to 37.5 degrees met these requirements. From the limited results it was observed that the identified models fit the data well and both the damping-in-roll and the unsteady term gain are decreasing with increasing sideslip and motion amplitude. Limited similarity between parameter values in the nonlinear model and the linear model suggest that identifiability of parameters in both terms may be a problem. However, the proposed methodology can still be used with careful experiment design and carefully selected

values of angle of attack, sideslip, amplitude, and frequency of the oscillatory data.
Author
F-16 Aircraft; Water Tunnel Tests; Unsteady Aerodynamics; Scale Models; Dynamic Tests; Mathematical Models

20040110807 NASA Langley Research Center, Hampton, VA, USA
Uncertainty-Based Approach for Dynamic Aerodynamic Data Acquisition and Analysis
Heim, Eugene H. D.; Bandon, Jay M.; [2004]; 13 pp.; In English; AIAA Atmospheric Flight Mechanics Conference, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 762-45-DB
Report No.(s): AIAA Paper 2004-5364; No Copyright; Avail: CASI; A03, Hardcopy

Development of improved modeling methods to provide increased fidelity of flight predictions for aircraft motions during flight in flow regimes with large nonlinearities requires improvements in test techniques for measuring and characterizing wind tunnel data. This paper presents a method for providing a measure of data integrity for static and forced oscillation test techniques. Data integrity is particularly important when attempting to accurately model and predict flight of today s high performance aircraft which are operating in expanded flight envelopes, often maneuvering at high angular rates at high angles-of-attack, even above maximum lift. Current aerodynamic models are inadequate in predicting flight characteristics in the expanded envelope, such as rapid aircraft departures and other unusual motions. Present wind tunnel test methods do not factor changes of flow physics into data acquisition schemes, so in many cases data are obtained over more iterations than required, or insufficient data may be obtained to determine a valid estimate with statistical significance. Additionally, forced oscillation test techniques, one of the primary tools used to develop dynamic models, do not currently provide estimates of the uncertainty of the results during an oscillation cycle. A method to optimize the required number of forced oscillation cycles based on decay of uncertainty gradients and balance tolerances is also presented.
Author
Data Acquisition; Mathematical Models; Wind Tunnel Tests; Civil Aviation; Oscillations; Data Processing; Aerodynamic Characteristics

20040110854 NASA Langley Research Center, Hampton, VA, USA
Development of Semi-Span Model Test Techniques
Pulnam, L. Elwood, Technical Monitor; Milholen, William E., II; Chokani, Ndaona; McGhee, Robert J.; [1996]; 15 pp.; In English; 14th AIAA Applied Aerodynamics Conference, 17-20 Jun. 1996, New Orleans, LA, USA
Contract(s)/Grant(s): NCC1-169
Report No.(s): AAA Paper 96-2412; Copyright; Avail: CASI; A03, Hardcopy

A computational investigation was performed to support the development of a semi-span model test capability in the NASA Langley Research Center's National Transonic Facility. This capability is desirable for the testing of advanced subsonic transport aircraft at full-scale Reynolds numbers. A state-of-the-art three-dimensional Navier-Stokes solver was used to examine methods to improve the flow over a semi-span configuration. First, a parametric study is conducted to examine the influence of the stand-off height on the flow over the semi-span model. It is found that decreasing the stand-off height, below the maximum fuselage radius, improves the aerodynamic characteristics of the semi-span model. Next, active sidewall boundary layer control techniques are examined. Juncture region blowing jets, upstream tangential blowing, and sidewall suction are found to improve the flow over the aft portion of the semi-span model. Both upstream blowing and suction are found to reduce the sidewall boundary layer separation. The resulting near surface streamline patterns are improved, and found to be quite similar to the full-span results. Both techniques however adversely affect the pitching moment coefficient.
Author
Semispan Models; Wind Tunnel Models; Transonic Wind Tunnels

20040110899 NASA Langley Research Center, Hampton, VA, USA
A Numerical Simulation Study to Develop an Acceptable Wake Encounter Boundary for a B737-100 Airplane
Vicroy, Dan D.; Nguyen, Truc; [1993]; 9 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The National Aeronautics and Space Administration (NASA) is conducting research with the goal of enabling safe improvements in the capacity of the nation's air transportation system. The wake-vortex upset hazard is an important factor in establishing the minimum safe spacing between aircraft during landing and take-off operations, thus impacting airport capacity. A batch simulation study was conducted to assess the sensitivity of various safe landing criteria in the development of an acceptable wake encounter boundary. A baseline six-degree-of-freedom simulation of a B737-100 airplane was modified

to include a wake model and the vortex-induced forces and moments. The guidance and control input for the airplane was provided by an auto-land system. The wake strength and encounter geometry were varied. A sensitivity study was also conducted to assess the effects of encounter modeling methods and accuracy.
Author
Boeing 737 Aircraft; Turbulent Wakes; Aircraft Wakes; Turbulence Models

20040110904 Eidgenoessische Technische Hochschule, Zurich, Switzerland
Influence of End Wall Leakage on Secondary Flow Development in Axial Turbines
Abhari, Reza; Schlienger, J.; Kalfas, A. I.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 56-77; In English; See also 20040110902
Contract(s)/Grant(s): BMWI-0327060D; BMWI-0327060F; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper presents steady and unsteady measurements of the 3 dimensional flow structure in a multistage axial turbine. The experiments were performed in a two stage axial research turbine facility, with the first stage being used to generate a realistic unsteady flow field at the inlet of the second stage. In this multistage environment, extensive measurements are taken in the second stage using Fast Response Aerodynamic Probes (FRAP). The influence of the strength of the leakage jet on the formation of secondary flow structure within the blade passage is studied. The results indicate that the labyrinth leakage flow strongly influences, and in many cases dominates the formation of the passage secondary flow vortex. A direct link between the strength of the passage vorticity and the related total pressure losses downstream of the passage is demonstrated. It is observed that for the cases studied, the classical linear cascade secondary flow structures does not provide the correct flow structure as measured. This result also suggests that when considering rotating multi-stage turbines with significant end-wall leakage flow, the unsteady interaction of the leakage re-entry would be an important design consideration for improved aerodynamic efficiency.
Author
Axial Flow Turbines; Leakage; Wall Flow; Flow Distribution; Aerodynamic Characteristics

20040110907 Royal Inst. of Tech., Stockholm, Sweden
Experimental and Numerical Study of Non-Linear Interactions in Transonic Nozzle Flow
Fransson, Torsten; Bron, Olivier; Allegret-Bourdon, Davy; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 520-523; In English; See also 20040110902; No Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Transonic flows about streamlined bodies are strongly affected, particularly near the shock location, by unsteady excitations. Experimental and computational studies have shown that the unsteady pressure distribution along the surface of an airfoil or a cascade blade in unsteady transonic flow exhibits a significant unsteady pressure bulge near the shock location whose phase variation results from non-linear interaction between the mean and unsteady flows. The shock motion, and thus the pressure distribution along the surface, can be critical regarding to the self-exciting oscillations of the airfoil. The sharp rise in the unsteady pressure distribution was due to near-sonic velocity that acts as an acoustic blockage barrier preventing acoustic disturbances from propagating upstream. The present investigation focuses the analysis on the shock features. Experiments have been carried out in a simple 2D convergent divergent nozzle, using multichannel transient pressure measurements, surface oil flow and Schlieren. Comparisons were made with numerical simulations utilizing a three-dimensional unsteady, compressible, Reynolds Averaged, Navier-Stokes solver.
Author
Unsteady Flow; Pressure Distribution; Transient Pressures; Nozzle Flow; Airfoils

20040110910 Indian Inst. of Science, Bangalore, India
Workshop Summary Transcript
Narasimha, Roddam; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 624-627; In English; See also 20040110902; No Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This talk is a personal reaction to the talks that had been given. The speaker, relates his thoughts about the issues of Turbine Machinery flow. Particularly he speaks in reference to the various types of simulations used, (i.e. Reynolds Averaged

Navier-Stokes, large-eddy simulation, and direct numerical simulations) in studying the Turbine flows.
CASI
Turbines; Computational Fluid Dynamics; Turbulence Models

20040110913 Arizona Univ., Tucson, AZ, USA
Control of Separation for Low Pressure Turbine Blades: Numerical Simulation
Fasel, H. F.; Gross, A.; Postl, D.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 355-391; In English; See also 20040110902
Contract(s)/Grant(s): F49620-02-1-0122; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In our investigations, Direct Numerical Simulations (DNS) are employed to aid in the understanding of the physical mechanism that are relevant for controlling flow separation from low pressure turbine (LPT) blades. Toward this end, we are performing both two- and three-dimensional simulations of the entire turbine cascade as well as of model geometries, utilizing various Navier-Stokes codes that have been developed in our research group.
Derived from text
Direct Numerical Simulation; Low Pressure; Navier-Stokes Equation; Separated Flow; Turbine Blades; Computational Fluid Dynamics

20040110921 California Univ., Davis, CA, USA
Skin Friction and Heat Flux Oscillations in Upstream Moving Wave Packets
Ryzhov, Oleg; Bogdanova-Ryzhova, Elena V.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 194-215; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Recent theoretical studies suggest that the wave/vortex eigenmodes coupling occurs in the linear stage of disturbance development under the influence of centrifugal forces. Subsonic boundary layers of two different types provide pertinent examples typical of turbomachinery environments. The first one relates to a three-dimensional motion with crossflow on a plate. The curvature of stream surfaces naturally warping in the crossflow direction maintains centrifugal forces. The second example corresponds to the two-dimensional boundary layer on a concave cylindrical surface. In this case centrifugal forces are supported by the fixed curvature of a solid surface bending in the streamwise direction. In both cases centrifugal forces are balanced out by the normal-to-wall pressure gradient. The inclusion of the vortex eigenmodes brought about by centrifugal forces makes an asymptotic approach selfconsistent at large Reynolds numbers. In the range of the wave / vortex eigenmode interactions the higher-order effects build up to magnitudes comparable to the leading-order contributions. Accordingly, the asymptotic approach gives rise to an extended version of the triple-deck theory with the main higher-order terms included in the system of governing equations. An essential broadening of the pulsation spectrum derives from the eigenmode coupling and results in two side bands emerging in the Tollmien-Schlichting interval of the eigen-frequencies and wavenumbers. Similarity laws show for each side band the dependence on different physical quantities such as wall shear, free-stream and wall temperatures among others. An inference of conceptual importance from the asymptotic model is that the boundary layer with crossflow much like the one on the concave surface suffers absolute instability in the streamwise direction which may result in earlier transition. Mechanical oscillations in the upstream propagating wave packets are capable of inducing temperature disturbances affecting the heat transfer across the turbine-blade surface. An asymptotic theory is advanced to embrace temperature pulsations in the range of the wave / vortex eigenmode interactions. The basic equation of the theory bears certain resemblance to that controlling the Squire eigenmode of three-dimensional disturbances. With a Mach number increasing, the impact of vortical eigenmodes on the skin friction and temperature pulsations becomes larger in high Reynolds number flows.
Author
Skin Friction; Heat Flux; Vortices; Upstream; Unsteady Flow; Oscillations

20040110925
Predicting Unsteady Buffet Onset Using RANS Solutions
Crouch, J. D.; Garbaruk, A.; Shur, M.; Strelets, M.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 565-583; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Results are presented for the onset of shedding for a low-Reynolds-number cylinder. This problem is characterized by an

incompressible laminar basic flow. The current results predict a critical Reynolds number for shedding of Re(sub c)=46.6. This is in good agreement with other's computational results, given Re(sub c)=46 +/1 1. Yet others predicted Re(sub c) = 39-42, and at Re(sub c)=46.2. The frequency for the onset of shedding is also well predicted. Results are also presented for transonic buffet on airfoils at high Reynolds numbers. A supersonic bubble, ending in a shock, followed by trailing-edge separation, characterizes these flows. As the shock becomes stronger, the separation point moves forward, and at some point the flow goes unsteady. For an 18% thick bi-convex airfoil, the critical Mach number and frequency for buffeting are in good agreement with other experiments and computations.
Derived from text
Buffeting; Reynolds Number; Cylindrical Bodies; Reynolds Averaging; Computational Fluid Dynamics; Turbulence Models

20040110931 Universidad Politecnica de Madrid, Madrid, Spain
Global Instability and Control of Low-Pressure Turbine Flows
Theofilis, Vassilis; Sherwin, Spencer J.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 26-55; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The present work is concerned with instabilities of flow in a low pressure turbine passage. The well-documented T-106 blade model is considered and two steps are taken. First, steady or time-periodic basic states are computed numerically, to be analyzed subsequently using BiGlobal Theory. A high-order spectral/hp element scheme is used for both the basic flow and the instability calculations. Appropriate space tessellations have been designed, which use classical h - refinement to resolve the boundary layers and then apply a high order polynominal expansion within each subdomain. In the case studied a p=8 polynominal order expansion has been applied within each elemental domain. This type of technique is also possible with unstructured domains and has the advantage that the surface geometry is also represented by high order polynominal expansions.
Derived from text
Stability; Linearity; Interactional Aerodynamics; Turbines; Blade-Vortex Interaction

20040110936 North Carolina State Univ., Raleigh, NC, USA
Hypervelocity Heat-Transfer Measurements in an Expansion Tube
Hollis, Brian R.; Perkins, John N.; [1996]; 12 pp.; In English; 19th AIAA Advanced Measurement and Ground Testing Technology Conference, 18-20 Jun. 1996, New Orleans, LA, USA
Contract(s)/Grant(s): NAGW-1331; NAG1-1663
Report No.(s): AIAA Paper 96-2240; Copyright; Avail: CASI; A03, Hardcopy

A series of experiments has been conducted in the NASA HYPULSE Expansion Tube, in both CO2 and air test gases, in order to obtain data for comparison with computational results and to assess the capability for performing hypervelocity heat-transfer studies in this facility. Heat-transfer measurements were made in both test gases on 70 deg sphere-cone models and on hemisphere models of various radii. HYPULSE freestream flow conditions in these test gases were found to be repeatable to within 3-10%, and aerothermodynamic test times of 150 microsec in CO2 and 125 microsec in air were identified. Heat-transfer measurement uncertainty was estimated to be 10-15%. Comparisons were made with computational results from the non-equilibrium Navier-Stokes solver NEQ2D. Measured and computed heat-transfer rates agreed to within 10% on the hemispheres and on the sphere-cone forebodies, and to within 10% in CO2 and 25% in air on the afterbodies and stings of the sphere-cone models.
Author
Test Facilities; Hypervelocity Flow; Heat Transfer; Aerodynamic Heating; Aerodynamics

20040110939 NASA Langley Research Center, Hampton, VA, USA
Geometric Model for a Parametric Study of the Blended-Wing-Body Airplane
Mastin, C. Wayne; Smith, Robert E.; Sadrehaghighi, Ideen; Wiese, Micharl R.; [1996]; 9 pp.; In English
Report No.(s): AIAA Paper 96-2416; Copyright; Avail: CASI; A02, Hardcopy

A parametric model is presented for the blended-wing-body airplane, one concept being proposed for the next generation of large subsonic transports. The model is defined in terms of a small set of parameters which facilitates analysis and optimization during the conceptual design process. The model is generated from a preliminary CAD geometry. From this geometry, airfoil cross sections are cut at selected locations and fitted with analytic curves. The airfoils are then used as boundaries for surfaces defined as the solution of partial differential equations. Both the airfoil curves and the surfaces are

generated with free parameters selected to give a good representation of the original geometry. The original surface is compared with the parametric model, and solutions of the Euler equations for compressible flow are computed for both geometries. The parametric model is a good approximation of the CAD model and the computed solutions are qualitatively similar. An optimal NURBS approximation is constructed and can be used by a CAD model for further refinement or modification of the original geometry.
Author
Blended-Wing-Body Configurations; Mathematical Models; Aircraft Models

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*.

20040095940 Mitre Corp., McLean, VA, USA
Exploration of Terminal Procedures Enabled by NASA Wake VAS Technologies
Lunsford, Clark R.; Smith, Arthur P., III; Cooper, Wayne W., Jr.; Mundra, Anand D.; Gross, Amy E.; Audenaerd, Laurence F.; Killian, Bruce E.; August 2004; 136 pp.; In English
Contract(s)/Grant(s): DTFA01-01-C-00001; NASA Order L-17121; 727-01-26
Report No.(s): NASA/CR-2004-213023; No Copyright; Avail: CASI; A07, Hardcopy

The National Aeronautics and Space Administration (NASA) tasked The MITRE Corporation's Center for Advanced Aviation System Development (CAASD) to investigate potential air traffic control (ATC) procedures that could benefit from technology used or developed in NASA's Wake Vortex Advisory System (WakeVAS). The task also required developing an estimate of the potential benefits of the candidate procedures. The main thrust of the investigation was to evaluate opportunities for improved capacity and efficiency in airport arrival and departure operations. Other procedures that would provide safety enhancements were also considered. The purpose of this investigation was to provide input to the WakeVAS program office regarding the most promising areas of development for the program. A two-fold perspective was desired: First, identification of benefits from possible procedures enabled by both incremental components and the mature state of WakeVAS technology; second identification of procedures that could be expected to evolve from the current Federal Aviation Administration (FAA) procedures. The evolution of procedures should provide meaningful increments of benefit and a low risk implementation of the WakeVAS technologies.
Author
Air Traffic Control; Vortex Advisory System; Technology Utilization

20040100708 General Accounting Office, Washington, DC
Commercial Aviation. Legacy Airlines Must Further Reduce Costs to Restore Profitability
Aug. 2004; 78 pp.; In English
Report No.(s): PB2004-107023; GAO-04-836; No Copyright; Avail: CASI; A05, Hardcopy

Since 2001, the U.S. airline industry has confronted financial losses of previously unseen proportions. From 2001 to 2003, the industry lost $23 billion, and two of the nation's biggest airlines have gone into bankruptcy. To assist airlines, the Congress provided U.S. airlines with $7 billion of direct financial assistance-most recently in the form of $2.4 billion of financial assistance under the 2003 Emergency Wartime Supplemental Appropriations Act. Under the Act and its accompanying conference report, the conferees directed GAO to review measures taken by airlines to reduce costs, improve revenues and profits, and strengthen their balance sheets. The Congress also tasked airlines receiving assistance to report their cost-cutting plans to GAO. GAO was also required to report on the financial condition of the U.S. airline industry by Vision 100 - Century of Aviation Reauthorization Act, which became law in January 2004. In consultation with the Congress, GAO agreed to satisfy these directives and report to the Congress on (1) the major challenges to the airline industry since 1998, (2) measures airlines report taking to remain financially viable, (3) the current financial and operating condition of the industry, and (4) how the competitiveness of the domestic airline industry has changed since 1998.
NTIS
Civil Aviation; Cost Reduction

20040100726 NASA Langley Research Center, Hampton, VA, USA

High Altitude Radiations Relevant to the High Speed Civil Transport (HSCT)

Wilson, J. W.; Goldhagan, P.; Maiden, D. L.; Tai, H.; [2004]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Langley Research Center (LaRC) performed atmospheric radiation studies under the SST development program in which important ionizing radiation components were measured and extended by calculations to develop the existing atmospheric ionizing radiation (AIR) model. In that program the measured neutron spectrum was limited to less than 10 MeV by the available 1960-1970 instrumentation. Extension of the neutron spectrum to high energies was made using the LaRC PROPER-3C monte carlo code. It was found that the atmospheric neutrons contributed about half of the dose equivalent and approximately half of the neutron contribution was from high energy neutrons above 10 MeV. Furthermore, monte carlo calculations of solar particle events showed that potential exposures as large as 10-100 mSv/hr may occur on important high latitude routes but acceptable levels of exposure could be obtained if timely descent to subsonic altitudes could be made. The principal concern was for pregnant occupants onboard the aircraft. As a result of these studies the FAA Advisory Committee on the Radiobiological Aspects of the SST recommended: 1. Crew members will have to be informed of their exposure levels 2. Maximum exposures on any flight to be limited to 5 mSv 3. Airborne radiation detection devices for total exposure and exposure rates 4. Satellite monitoring system to provide SST aircraft real-time information on atmospheric radiation levels for exposure mitigation 5. A solar forecasting system to warn flight operations of an impending solar event for flight scheduling and alert status. These recommendations are a reasonable starting point to requirements for the HSCT with some modification reflecting new standards of protection as a result of changing risk coefficients.

Author

Radiation Dosage; Supersonic Transports; Atmospheric Radiation; Neutrons; Civil Aviation; Flight Crews; Ionizing Radiation

20040110244 NASA Langley Research Center, Hampton, VA, USA

Wings: A New Paradigm in Human-Centered Design

Schutte, Paul C.; [1997]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Many aircraft accidents/incidents investigations cite crew error as a causal factor (Boeing Commercial Airplane Group 1996). Human factors experts suggest that crew error has many underlying causes and should be the start of an accident investigation and not the end. One of those causes, the flight deck design, is correctable. If a flight deck design does not accommodate the human's unique abilities and deficits, crew error may simply be the manifestation of this mismatch. Pilots repeatedly report that they are 'behind the aircraft' , i.e., they do not know what the automated aircraft is doing or how the aircraft is doing it until after the fact. Billings (1991) promotes the concept of 'human-centered automation"; calling on designers to allocate appropriate control and information to the human. However, there is much ambiguity regarding what it mean's to be human-centered. What often are labeled as 'human-centered designs' are actually designs where a human factors expert has been involved in the design process or designs where tests have shown that humans can operate them. While such designs may be excellent, they do not represent designs that are systematically produced according to some set of prescribed methods and procedures. This paper describes a design concept, called Wings, that offers a clearer definition for human-centered design. This new design concept is radically different from current design processes in that the design begins with the human and uses the human body as a metaphor for designing the aircraft. This is not because the human is the most important part of the aircraft (certainly the aircraft would be useless without lift and thrust), but because he is the least understood, the least programmable, and one of the more critical elements. The Wings design concept has three properties: a reversal in the design process, from aerodynamics-, structures-, and propulsion-centered to truly human-centered; a design metaphor that guides function allocation and control and display design; and a deliberate distinction between two fundamental functions of design, to complement and to interpret human performance. The complementary function extends the human's capabilities beyond his or her current limitations - this includes sensing, computation, memory, physical force, and human decision making styles and skills. The interpretive (or hermeneutic, Hollnagel 1991) function translates information, functionality, and commands between the human and the aircraft. The Wings design concept allows the human to remain aware of the aircraft through natural interpretation. It also affords great improvements in system performance by maximizing the human's natural abilities and complementing the human's skills in a natural way. This paper will discuss the Wings design concept by describing the reversal in the traditional design process, the function allocation strategy of Wings, and the functions of complementing and interpreting the human.

Author

Accident Investigation; Aircraft Accidents; Computation

20040110271 NASA Langley Research Center, Hampton, VA, USA

A Formal Methods Approach to the Analysis of Mode Confusion

Butler, Ricky W.; Miller, Steven P.; Potts, James N.; Carreno, Victor A.; [2004]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The goal of the new NASA Aviation Safety Program (AvSP) is to reduce the civil aviation fatal accident rate by 80% in ten years and 90% in twenty years. This program is being driven by the accident data with a focus on the most recent history. Pilot error is the most commonly cited cause for fatal accidents (up to 70%) and obviously must be given major consideration in this program. While the greatest source of pilot error is the loss of situation awareness , mode confusion is increasingly becoming a major contributor as well. The January 30, 1995 issue of Aviation Week lists 184 incidents and accidents involving mode awareness including the Bangalore A320 crash 2/14/90, the Strasbourg A320 crash 1/20/92, the Mulhouse-Habsheim A320 crash 6/26/88, and the Toulouse A330 crash 6/30/94. These incidents and accidents reveal that pilots sometimes become confused about what the cockpit automation is doing. Consequently, human factors research is an obvious investment area. However, even a cursory look at the accident data reveals that the mode confusion problem is much deeper than just training deficiencies and a lack of human-oriented design. This is readily acknowledged by human factors experts. It seems that further progress in human factors must come through a deeper scrutiny of the internals of the automation. It is in this arena that formal methods can contribute. Formal methods refers to the use of techniques from logic and discrete mathematics in the specification, design, and verification of computer systems, both hardware and software. The fundamental goal of formal methods is to capture requirements, designs and implementations in a mathematically based model that can be analyzed in a rigorous manner. Research in formal methods is aimed at automating this analysis as much as possible. By capturing the internal behavior of a flight deck in a rigorous and detailed formal model, the dark corners of a design can be analyzed. This paper will explore how formal models and analyses can be used to help eliminate mode confusion from flight deck designs and at the same time increase our confidence in the safety of the implementation. The paper is based upon interim results from a new project involving NASA Langley and Rockwell Collins in applying formal methods to a realistic business jet Flight Guidance System (FGS).

Author (revised)

Aircraft Accidents; Pilot Error; Error Analysis; Situational Awareness; Formalism

20040110326 NASA Langley Research Center, Hampton, VA, USA

Flight Testing of an Airport Surface Guidance, Navigation, and Control System

Young, Steven D.; Jones, Denise R.; [1998]; 12 pp.; In English; ION National Technical Meeting, 21-23 Jan. 1998, USA; No Copyright; Avail: CASI; A03, Hardcopy

This document describes operations associated with a set of flight experiments and demonstrations using a Boeing-757-200 (B-757) research aircraft as part of low visibility landing and surface operations (LVLASO) research activities. To support this experiment, the B-757 performed flight and taxi operations at the Hartsfield-Atlanta International Airport (ATL) in Atlanta, GA. The B-757 was equipped with experimental displays that were designed to provide flight crews with sufficient information to enable safe, expedient surface operations in any weather condition down to a runway visual range (RVR) of 300 feet. In addition to flight deck displays and supporting equipment onboard the B-757, there was also a ground-based component of the system that provided for ground controller inputs and surveillance of airport surface movements. The integrated ground and airborne components resulted in a system that has the potential to significantly improve the safety and efficiency of airport surface movements particularly as weather conditions deteriorate. Several advanced technologies were employed to show the validity of the operational concept at a major airport facility, to validate flight simulation findings, and to assess each of the individual technologies performance in an airport environment. Results show that while the maturity of some of the technologies does not permit immediate implementation, the operational concept is valid and the performance is more than adequate in many areas.

Author

Airports; Boeing 757 Aircraft; Flight Tests; Surface Navigation; Control Systems Design

20040110333 NASA Langley Research Center, Hampton, VA, USA

Preliminary Validation of the Small Aircraft Transportation System Higher Volume Operations (SATS HVO) Concept

Williams, Daniel; Consiglio, Maria; Murdoch, Jennifer; Adams, Catherine; [2004]; 10 pp.; In English; 24th Congress of International Councils of Aeronautical Sciences, 29 Aug. - 4 Sep. 2004, Yokohama, Japan; No Copyright; Avail: CASI; A02, Hardcopy

This document provides a preliminary validation of the Small Aircraft Transportation System (SATS) Higher Volume Operations (HVO) concept for normal conditions. Initial results reveal that the concept provides reduced air traffic delays

when compared to current operations without increasing pilot workload. Characteristic to the SATS HVO concept is the establishment of a newly defined area of flight operations called a Self-Controlled Area (SCA) which would be activated by air traffic control (ATC) around designated non-towered, non-radar airports. During periods of poor visibility, SATS pilots would take responsibility for separation assurance between their aircraft and other similarly equipped aircraft in the SCA. Using onboard equipment and simple instrument flight procedures, they would then be better able to approach and land at the airport or depart from it. This concept would also require a new, ground-based automation system, typically located at the airport that would provide appropriate sequencing information to the arriving aircraft. Further validation of the SATS HVO concept is required and is the subject of ongoing research and subsequent publications.
Author
Air Transportation; Air Traffic Control; Civil Aviation; Flight Operations

20040110337 Old Dominion Univ., Hampton, VA, USA
Scale-Free Networks and Commercial Air Carrier Transportation in the USA
Conway, Sheila R.; [2004]; 12 pp.; In English; 24th International Congress of the Aeronautical Sciences, 2004; No Copyright; Avail: CASI; A03, Hardcopy

Network science, or the art of describing system structure, may be useful for the analysis and control of large, complex systems. For example, networks exhibiting scale-free structure have been found to be particularly well suited to deal with environmental uncertainty and large demand growth. The National Airspace System may be, at least in part, a scalable network. In fact, the hub-and-spoke structure of the commercial segment of the NAS is an often-cited example of an existing scale-free network After reviewing the nature and attributes of scale-free networks, this assertion is put to the test: is commercial air carrier transportation in the USA well explained by this model? If so, are the positive attributes of these networks, e.g. those of efficiency, flexibility and robustness, fully realized, or could we effect substantial improvement? This paper first outlines attributes of various network types, then looks more closely at the common carrier air transportation network from perspectives of the traveler, the airlines, and Air Traffic Control (ATC). Network models are applied within each paradigm, including discussion of implied strengths and weaknesses of each model. Finally, known limitations of scalable networks are discussed. With an eye towards NAS operations, utilizing the strengths and avoiding the weaknesses of scale-free networks are addressed.
Author
Air Transportation; Transportation Networks; United States; Commercial Aircraft; Airline Operations

20040110378 NASA Langley Research Center, Hampton, VA, USA
Transformations in Air Transportation Systems For the 21st Century
Holmes, Bruce J.; [2004]; 16 pp.; In English; International Council for Aeronautics and Space Twenty-Fourth Congress, 2004, Yokohama, Japan; No Copyright; Avail: CASI; A03, Hardcopy

Globally, our transportation systems face increasingly discomforting realities: certain of the legacy air and ground infrastructures of the 20th century will not satisfy our 21st century mobility needs. The consequence of inaction is diminished quality of life and economic opportunity for those nations unable to transform from the 20th to 21st century systems. Clearly, new thinking is required regarding business models that cater to consumers value of time, airspace architectures that enable those new business models, and technology strategies for innovating at the system-of-networks level. This lecture proposes a structured way of thinking about transformation from the legacy systems of the 20th century toward new systems for the 21st century. The comparison and contrast between the legacy systems of the 20th century and the transformed systems of the 21st century provides insights into the structure of transformation of air transportation. Where the legacy systems tend to be analog (versus digital), centralized (versus distributed), and scheduled (versus on-demand) for example, transformed 21st century systems become capable of scalability through technological, business, and policy innovations. Where air mobility in our legacy systems of the 20th century brought economic opportunity and quality of life to large service markets, transformed air mobility of the 21st century becomes more equitable available to ever-thinner and widely distributed populations. Several technological developments in the traditional aircraft disciplines as well as in communication, navigation, surveillance and information systems create new foundations for 21st thinking about air transportation. One of the technological developments of importance arises from complexity science and modern network theory. Scale-free (i.e., scalable) networks represent a promising concept space for modeling airspace system architectures, and for assessing network performance in terms of robustness, resilience, and other metrics. The lecture offers an air transportation system topology and a scale-free network linkage graphic as framework for transportation system innovation. Successful outcomes of innovation in air transportation could lay the foundations for new paradigms for aircraft and their operating capabilities, air transportation system topologies,

and airspace architectures and procedural concepts. These new paradigms could support scalable alternatives for the expansion of future air mobility to more consumers in more parts of the world.
Author
Air Transportation; Systems Engineering; Technology Utilization; Civil Aviation

20040110405 NASA Langley Research Center, Hampton, VA, USA
The Joint Winter Runway Friction Measurement Program: NASA Perspective
Yager, Thomas J.; [1996]; 16 pp.; In English; 1st International Meeting on Aircraft Performance on Contaminated Runways, 22-23 Oct. 1996, Montreal, Quebec, Canada; No Copyright; Avail: CASI; A03, Hardcopy

Some background information is given together with the scope and objectives of the 5-year, Joint National Aeronautics & Space Administration (NASA)/Transport Canada (TC)/Federal Aviation Administration (FAA) Winter Runway Friction Measurement Program. The range of the test equipment, the selected test sites and a tentative test program schedule are described. NASA considers the success of this program critical in terms of insuring adequate ground handling performance capability in adverse weather conditions for future aircraft being designed and developed as well as improving the safety of current aircraft ground operations.
Author
Friction Measurement; Runways; NASA Programs; Winter; Weather; Civil Aviation

20040110722 NASA Langley Research Center, Hampton, VA, USA
Reduction of Weather-Related Terminal Area Delays in the Free-Flight Era
Johnson, Sally C.; Chin, David K.; Rovinsky, Robert B.; Kostiuk, Peter F.; Lee, David A.; Hemm, Robert V.; Wingrove, Earl R., III; [1996]; 6 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

While much of the emphasis of the free-flight movement has been concentrated on reducing en-route delays, airport capacity is a major bottleneck in the current airspace system, particularly during bad weather. According to the Air Transport Association (ATA) Air Carrier Delay Reports, ground delays (gate-hold, taxi-in, and taxi-out) comprise 75 percent of total delays. It is likely that the projected steady growth in traffic will only exacerbate these losses. Preliminary analyses show that implementation of the terminal area technologies and procedures under development in NASA s Terminal Area Productivity program can potentially save the airlines at least $350M annually in weather-related delays by the year 2005 at Boston Logan and Detroit airports alone. This paper briefly describes the Terminal Area Productivity program, outlines the costhenefit analyses that are being conducted in support of the program, and presents some preliminary analysis results.
Author
Free Flight; Weather; Air Transportation; Terminals; Civil Aviation

20040110780 NASA Langley Research Center, Hampton, VA, USA
Small Aircraft Transportation System, Higher Volume Operations Concept: Normal Operations
Abbott, Terence S.; Jones, Kenneth M.; Consiglio, Maria C.; Williams, Daniel M.; Adams, Catherine A.; August 2004; 29 pp.; In English
Contract(s)/Grant(s): WU 23-786-10-10
Report No.(s): NASA/TM-2004-213022; L-18368; No Copyright; Avail: CASI; A03, Hardcopy

This document defines the Small Aircraft Transportation System (SATS), Higher Volume Operations (HVO) concept for normal conditions. In this concept, a block of airspace would be established around designated non-towered, non-radar airports during periods of poor weather. Within this new airspace, pilots would take responsibility for separation assurance between their aircraft and other similarly equipped aircraft. Using onboard equipment and procedures, they would then approach and land at the airport. Departures would be handled in a similar fashion. The details for this operational concept are provided in this document.
Author
Flight Operations; Airports; Civil Aviation

20040110976 North Carolina State Univ., Raleigh, NC, USA
Characterizing the Severe Turbulence Environments Associated With Commercial Aviation Accidents: A Real-Time Turbulence Model (RTTM) Designed for the Operational Prediction of Hazardous Aviation Turbulence Environments
Kaplan, Michael L.; Lux, Kevin M.; Cetola, Jeffrey D.; Huffman, Allan W.; Riordan, Allen J.; Slusser, Sarah W.; Lin, Yuh-Lang; Charney, Joseph J.; Waight, Kenneth T.; August 2004; 54 pp.; In English
Contract(s)/Grant(s): NAS1-02007; 32-728-40-30
Report No.(s): NASA/CR-2004-213025; No Copyright; Avail: CASI; A04, Hardcopy

Real-time prediction of environments predisposed to producing moderate-severe aviation turbulence is studied. We describe the numerical model and its postprocessing system designed for said prediction of environments predisposed to severe aviation turbulence as well as presenting numerous examples of its utility. The numerical model is MASS version 5.13, which is integrated over three different grid matrices in real time on a university work station in support of NASA Langley Research Center s B-757 turbulence research flight missions. The postprocessing system includes several turbulence-related products, including four turbulence forecasting indices, winds, streamlines, turbulence kinetic energy, and Richardson numbers. Additionally, there are convective products including precipitation, cloud height, cloud mass fluxes, lifted index, and K-index. Furthermore, soundings, sounding parameters, and Froude number plots are also provided. The horizontal cross-section plot products are provided from 16 000 to 46 000 ft in 2000-ft intervals. Products are available every 3 hours at the 60- and 30-km grid interval and every 1.5 hours at the 15-km grid interval. The model is initialized from the NWS ETA analyses and integrated two times a day.
Author
Turbulence Models; Real Time Operation; Prediction Analysis Techniques; Forecasting; Mathematical Models

20040110997 Civil Aerospace Medical Inst., Oklahoma City, OK, USA
Simulated Evacuations Into Water
McLean, Garnet A.; Palmerton, David A.; Corbett, Cynthia; Larcher, Kenneth G.; McDown, Jerry R.; August 2004; 12 pp.; In English
Contract(s)/Grant(s): DOT-AM-B-01-PRS-93
Report No.(s): DOT/FAA/AM-04/12; No Copyright; Avail: CASI; A03, Hardcopy

Transport airplanes are required to be assessed for ditching capability in the FAA type-certification process. This includes the airplane's emergency evacuation potential, i.e., the ability of passengers to escape the airplane after it lands on water. Actual emergency data to support ditching certification are not available; there have been questions as to whether evacuation flow rates onto land are appropriate for use in ditching-related flotation time computations. Simulated evacuations from platforms into the CAMI survival tank were conducted to obtain passenger flow rate data that can be used to support the certification process. A 12 ft x 12 ft platform was placed next to the tank. Platform (exit sill) heights of 9 in, 2 ft, 4 ft, and 6 ft were employed; flotation seat cushions and inflatable life vests were used as individual flotation aids. Four subject groups performed three simulated evacuations at each platform height through a Type-I exit-sized opening; four other groups similarly used a Type-A exit-sized opening. A significant effect (p\h.001) of platform height above the water was found, as increasing heights resulted in monotonic decreases in flow rate. A significant effect (p\h.01) of flotation device type was also found, with flotation seat cushions producing the lowest flow rates, followed next by life vests that were uninflated until entry into the water, and then life vests that had been inflated before leaving the platform. Finally, the Type-A exit-sized platform configuration was significantly faster than was the Type-I configuration (p\h.05). These effects suggest that in the best conditions, passenger flow rates into water are much like those onto land. However, the platform height effects suggest that airplane attitude in the water may be important, as is exit size. The use of flotation seat cushions as flotation aids should be a last resort.
Author
Transport Aircraft; Evacuating (Transportation); Passengers; Egress; Safety Factors; Emergency Landing; Water Landing; Passenger Aircraft; Hatches

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*.

20040095934 NASA Langley Research Center, Hampton, VA, USA
Pilot Mental Workload with Predictive System Status Information
Trujillo, Anna C.; [1998]; 8 pp.; In English; Fourth Symposium on Human Interaction with Complex Systems, 22-24 Mar. 1998, OH, USA; No Copyright; Avail: CASI; A02, Hardcopy

Research has shown a strong pilot preference for predictive information of aircraft system status in the flight deck. However, the mental workload associated with using this predictive information has not been ascertained. The study described here attempted to measure mental workload. In this simulator experiment, three types of predictive information (none, whether

a parameter was changing abnormally, and the time for a parameter to reach an alert range) and four initial times to a parameter alert range (1 minute, 5 minutes, 15 minutes, and ETA+45 minutes) were tested to determine their effects on subjects mental workload. Subjective workload ratings increased with increasing predictive information (whether a parameter was changing abnormally or the time for a parameter to reach an alert range). Subjective situation awareness decreased with more predictive information but it became greater with increasing initial times to a parameter alert range. Also, subjective focus changed depending on the type of predictive information. Lastly, skin temperature fluctuated less as the initial time to a parameter alert range increased.
Author
Mental Performance; Workloads (Psychophysiology); Pilots; Pilot Support Systems; Predictions

20040105534 NASA Langley Research Center, Hampton, VA, USA
The Benchmark Active Controls Technology Model Aerodynamic Data
Scott, Robert C.; Hoadley, Sherwood T.; Wieseman, Carol D.; Durham, Michael H.; [1997]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The Benchmark Active Controls Technology (BACT) model is a part of the Benchmark Models Program (BMP). The BMP is a NASA Langley Research Center program that includes a series of models which were used to study different aeroelastic phenomena and to validate computational fluid dynamics codes. The primary objective of BACT testing was to obtain steady and unsteady loads, accelerations, and aerodynamic pressures due to control surface activity in order to calibrate unsteady CFD codes and active control design tools. Three wind-tunnel tests in the Transonic Dynamics Tunnel (TDT) have been completed. The first and parts of the second and third tests focused on collecting open-loop data to define the model's aeroservoelastic characteristics, including the flutter boundary across the Mach range. It is this data that is being presented in this paper. An extensive database of over 3000 data sets was obtained. This database includes steady and unsteady control surface effectiveness data, including pressure distributions, control surface hinge moments, and overall model loads due to deflections of a trailing edge control surface and upper and lower surface
Author
Computational Fluid Dynamics; Aeroservoelasticity; Unsteady Aerodynamics; Pressure Distribution; Data Acquisition

20040110256 NASA Langley Research Center, Hampton, VA, USA
Comparison of A-SMGCS Requirements with Observed Performance of an Integrated Airport CNS System
Young, Steven D.; [1997]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The International Civil Aviation Organization (ICAO) has recently drafted a reference document describing the operational requirements for Advanced Surface Movement Guidance and Control Systems (A-SMGCS). During the summer of 1997, NASA, the FAA, industry, and academia partners demonstrated a holistic system approach that has the potential to meet many of the proposed A-SMGCS requirements. An assessment of the field tested system and data resulting from the field testing is presented to determine its compliance with A-SMGCS requirements. In those areas where compliance was not demonstrated, a recommendation is presented suggesting further research or a modification of the system architecture.
Author
Guidance (Motion); Aircraft Safety; Airports; Air Traffic Control; Surface Navigation; Systems Integration

20040110268 NASA Langley Research Center, Hampton, VA, USA
Airport Surface Movement Technologies: Atlanta Demonstrations Overview
Jones, Denise R.; Young, Steven D.; [1997]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A flight demonstration was conducted in August 1997 at the Hartsfield Atlanta (ATL) International Airport as part of low visibility landing and surface operations (LVLASO) research activities. This research was aimed at investigating technology to improve the safety and efficiency of aircraft movements on the surface during the operational phases of roll-out, turnoff, and taxi in any weather condition down to a runway visual range of 300 feet. The system tested at ATL was composed of airborne and ground-based components that were integrated to provide both the flight crew and controllers with supplemental information to enable safe, expedient surface operations. Experimental displays were installed on a Boeing 757-200 research aircraft in both headup and head-down formats. On the ground, an integrated system maintained surveillance of the airport surface and a controller interface provided routing and control instructions. While at ATL, the research aircraft performed a series of flight and taxi operations to show the validity of the operational concept at a major airport facility, to validate simulation findings, and to assess each of the individual technologies performance in an airport environment. The concept was

demonstrated to over 100 visitors from the Federal Aviation Administration (FAA) and the aviation community. This paper gives an overview of the LVLASO system and ATL test activities.
Author
Airports; Operations Research; Flight Operations; Low Visibility; Runways; Aircraft Landing; Surface Navigation; Air Traffic Controllers (Personnel); Flight Tests

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*.

20040095914 Army Research Lab., Hampton, VA, USA
Debonding in Composite Skin/Stringer Configurations Under Multi-Axial Loading
Cvitkovich, Michael K.; Krueger, Ronald; OBrien, T.; Minguet, Pierre J.; January 2004; 35 pp.; In English; 13th Annual Technical Conference on Composite Materials, 21-23 Sep. 1998, Baltimore, MD, USA; No Copyright; Avail: CASI; A03, Hardcopy

The objective of this work was to investigate the damage mechanisms in composite bonded skin/stringer constructions under uniaxial and biaxial (in-plane/out-of-plane) loading conditions as typically experienced by aircraft crown fuselage panels. The specimens for all tests were identical and consisted of a tapered composite flange, representing a stringer or frame, bonded onto a composite skin. Tests were performed under monotonic loading conditions in tension, three-point bending, and combined tension/bending to evaluate the debonding mechanisms between the skin and the bonded stringer. For combined tension/bending testing, a unique servohydraulic load frame was used that was capable of applying both loads simultaneously. Microscopic investigations of the specimen edges were used to document the damage occurrence and to identify typical damage patterns. The observations showed that, for all three load cases, failure initiated in the flange near the flange tip causing the flange to almost fully debond from the skin. A two-dimensional plain-strain finite element model was developed to analyze the different test cases using a geometrically nonlinear solution. For all three loading conditions, principal stresses exceeded the transverse strength of the material in the flange area. Additionally, delaminations of various lengths were simulated in the locations where delaminations were experimentally observed. The analyses showed that unstable delamination propagation is likely to occur at the loads corresponding to matrix ply crack initiation for all three loadings.
Author
Aircraft Structures; Bending; Crack Initiation; Damage; Debonding (Materials); Mathematical Models

20040095919 NASA Langley Research Center, Hampton, VA, USA
Waveform Analysis of AE in Composites
Prosser, William H.; Proceedings of the Sixth International Symposium on Acoustic Emission From Composite Materials; [1998], pp. 61-70; In English; Sixth International Symposium on Acoustic Emission from Composite Materials, Jun. 1998, San Antonio, TX, USA; No Copyright; Avail: CASI; A02, Hardcopy

Advanced, waveform based acoustic emission (AE) techniques have been developed to evaluate damage mechanisms in the testing of composite materials. This approach, more recently referred to as Modal AE, provides an enhanced capability to discriminate and eliminate noise signals from those generated by damage mechanisms. Much more precise source location can also be obtained in comparison to conventional, threshold crossing arrival time determination techniques. Two successful examples of the application of Modal AE are presented in this work. In the first, the initiation of transverse matrix cracking in cross-ply, tensile coupons was monitored. In these tests, it was documented that the same source mechanism, matrix cracking, can produce widely different AE signal amplitudes dependent on laminate stacking sequence and thickness. These results, taken together with well known propagation effects of attenuation and dispersion of AE signals in composite laminates, cast further doubt on the validity of simple amplitude or amplitude distribution analysis for AE source determination. For the second example, delamination propagation in composite ring specimens was monitored. Pressurization of these composite rings is used to simulate the stresses in a composite rocket motor case. AE signals from delamination propagation were characterized by large amplitude flexural plate mode components which have long signal durations because of the large dispersion of this mode.
Author
Acoustic Emission; Waveforms; Degradation; Delaminating; Composite Materials

20040095939 NASA Dryden Flight Research Center, Edwards, CA, USA

A Review of Solar-Powered Aircraft Flight Activity at the Pacific Missile Range Test Facility, Kauai, Hawaii

Ehemberger, L. J.; Donohue, Casey; Teets, Edward H., Jr.; [2004]; 7 pp.; In English; 11h AMS Conference on Aviation, Range, and Aerospace Meteorology, 4-8 Oct. 2004, Hyannis, MA, USA; No Copyright; Avail: CASI; A02, Hardcopy

A series of solar-powered aircraft have been designed and operated by AeroVironment, Inc. (Monrovia, CA) as a part of National Aeronautics and Space Administration (NASA) objectives to develop energy-efficient high-altitude long-endurance platforms for earth observations and communications applications. Flight operations have been conducted at NASA's Dryden Flight Research Center, Edwards CA and at the U.S. Navy Pacific Missile Range Facility (PMRF) at Barking Sands, Kauai, HI. These aircraft flown at PMRF are named Pathfinder , Pathfinder Plus and Helios . Sizes of these three aircraft range from 560 lb with a 99-ft wingspan to 2300 lb with a 247-ft wingspan. Available payload capacity reaches approximately 200 lb. Pathfinder uses six engines and propellers: Pathfinder Plus 8; and Helios 14. The 2003 Helios fuel cell configurations used 10 engines and propellers. The PMRF was selected as a base of operations because if offers optimal summertime solar exposure, low prevailing wind-speeds on the runway, modest upper-air wind-speeds and the availability of suitable airspace. Between 1997 and 2001, successive altitude records of 71,530 ft, 80,200 ft, and 96,863 ft were established. Flight durations extended to 18 hours.

Derived from text

Flight Operations; Fuel Cells; Solar Powered Aircraft; Wind Velocity

20040095951 NASA Langley Research Center, Hampton, VA, USA

Rarefied Transitional Bridging of Blunt Body Aerodynamics

Wilmoth, R. G.; Blanchard, R. C.; Moss, J. N.; [1998]; 8 pp.; In English; 21st International Symposium on Rarefied Gas Dynamics, 26-31 Jul. 1998, Marseille, France; No Copyright; Avail: CASI; A02, Hardcopy

The bridging procedures discussed provide an accurate engineering method for predicting rarefied transitional aerodynamics of spherically-blunted cone entry vehicles. The single-point procedure offers a way to improve the bridging procedures while minimizing the computational effort. However, the accuracy of these procedures ultimately depends on accurate knowledge of the aerodynamics in the free-molecular and continuum limits. The excellent agreement shown for DSMC predictions and bridging relations with the Viking flight data in transitional regime enhance the coincidence in these procedures.

Derived from text

Blunt Bodies; Rarefied Gas Dynamics; Conical Bodies; Aerodynamic Configurations

20040100751 NASA Langley Research Center, Hampton, VA, USA

Flight Acoustics Measurement Techniques and Applications

Preisser, J. S.; Marcolini, M. A.; [1998]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Careful consideration must be given to data acquisition and analysis techniques in the design of experiments for the measurement of noise generated by flight vehicles. Although noise measurement locations and data reduction procedures are specified for aircraft certification by FAA and ICAO directives, for example, there are virtually no established procedures for aircraft noise measurement for other purposes. To optimize the quality and quantity of information obtained in a flight acoustics experiment, microphone layout, data acquisition, and analysis must be tailored to the specific test objective. This paper will review flight acoustics technology at NASA Langley Research Center developed over the past decade. In particular, the paper will focus on flight experiments performed for three diverse objectives: (1) research applications, such as noise prediction code validation, (2) noise impact modeling, and (3) noise abatement flight procedures. To best achieve these diverse objectives, different deployments of microphone systems on the ground are required, and different data analysis techniques are needed. In all cases, accurate positioning of the aircraft synchronized in time with the data recording is necessary. However, there are some restrictions on flight operations unique to each case for the methods to properly work.

Derived from text

Acoustics; Noise Measurement; Aeroacoustics; Data Acquisition; Aircraft Models; Rotary Wing Aircraft

20040100752 NASA Langley Research Center, Hampton, VA, USA

Measurement of Rotorcraft Blade Deformation using Projection Moire Interferometry

Fleming, Gary A.; Gorton, Susan Althoff; [1998]; 14 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Projection Moire Interferometry (PMI) has been used to obtain near instantaneous, quantitative blade deformation measurements of a generic rotorcraft model at several test conditions. These laser-based measurements provide quantitative,

whole field, dynamic blade deformation profiles conditionally sampled as a function of rotor azimuth. The instantaneous nature of the measurements permits computation of the mean and unsteady blade deformation, blade bending, and twist. The PMI method is presented, and the image processing steps required to obtain quantitative deformation profiles from PMI interferograms are described. Experimental results are provided which show blade bending, twist, and unsteady motion. This initial proof-of-concept test has demonstrated the capability of PMI to acquire accurate, full field rotorcraft blade deformation data.
Author
Moire Interferometry; Rotary Wing Aircraft; Deformation; Image Processing; Helicopters; Deflection; Rotors

20040100762 NASA Langley Research Center, Hampton, VA, USA
Characterizing the Hazard of a Wake Vortex Encounter
Vicroy, Dan D.; Brandon, Jay; Greene, George; Rivers, Robert; Shah, Gautam; Stewart, Eric; Stuever, Robert; [1998]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The National Aeronautics and Space Administration (NASA) is conducting research with the goal of enabling safe improvements in the capacity of the nation's air transportation system. The wake vortex upset hazard is an important factor in establishing the minimum safe spacing between aircraft during landing and take-off operations, thus impacting airport capacity. Static and free-flight wind tunnel tests and flight tests have provided an extensive data set for improved understanding of vortex encounter dynamics and simulation. Piloted and batch simulation studies are also ongoing to establish a first-order hazard metric and determine the limits of an operationally acceptable wake induced upset. This paper outlines NASA's research in these areas.
Author
Flight Tests; NASA Programs; Wind Tunnel Tests; Blade-Vortex Interaction; Aircraft Wakes; Aircraft Hazards

20040100767 NASA Langley Research Center, Hampton, VA, USA
Two Dimensional Wake Vortex Simulations in the Atmosphere: Preliminary Sensitivity Studies
Proctor, F. H.; Hinton, D. A.; Han, J.; Schowalter, D. G.; Lin, Y.-L.; [1998]; 13 pp.; In English
Contract(s)/Grant(s): NCC1-188; Copyright; Avail: CASI; A03, Hardcopy

A numerical large-eddy simulation model is currently being used to quantify aircraft wake vortex behavior with meteorological observables. The model, having a meteorological framework, permits the interaction of wake vortices with environments characterized by crosswind shear, stratification, and humidity. The addition of grid-scale turbulence as an initial condition appeared to have little consequence. Results show that conventional nondimensionalizations work very well for vortex pairs embedded in stably stratified flows. However, this result is based on simple environments with constant Brunt-Vaisala frequency. Results presented here also show that crosswind profiles exert important and complex interactions on the trajectories of wake vortices. Nonlinear crosswind profiles tended to arrest the descent of wake vortex pairs. The member of the vortex pair with vorticity of same sign as the vertical change in the ambient along-track vorticity may be deflected upwards.
Author
Aircraft Wakes; Large Eddy Simulation; Vortices; Earth Atmosphere; Aircraft Approach Spacing; Two Dimensional Models; Sensitivity Analysis

20040100813 NASA Langley Research Center, Hampton, VA, USA
Aerodynamic Design Optimization on Unstructured Grids with a Continuous Adjoint Formulation
Anderson, W. Kyle; Venkatakrishnan, V.; [1997]; 17 pp.; In English
Report No.(s): AIAA Paper 97-0643; Copyright; Avail: CASI; A03, Hardcopy

A continuous adjoint approach for obtaining sensitivity derivatives on unstructured grids is developed and analyzed. The derivation of the costate equations is presented, and a second-order accurate discretization method is described. The relationship between the continuous formulation and a discrete formulation is explored for inviscid, as well as for viscous flow. Several limitations in a strict adherence to the continuous approach are uncovered, and an approach that circumvents these difficulties is presented. The issue of grid sensitivities, which do not arise naturally in the continuous formulation, is investigated and is observed to be of importance when dealing with geometric singularities. A method is described for modifying inviscid and viscous meshes during the design cycle to accommodate changes in the surface shape. The accuracy

of the sensitivity derivatives is established by comparing with finite-difference gradients and several design examples are presented.
Author
Design Optimization; Finite Difference Theory; Inviscid Flow; Surface Properties; Unstructured Grids (Mathematics)

20040105596 NASA Langley Research Center, Hampton, VA, USA
NASA Wake Vortex Research for Aircraft Spacing
Perry, R. Brad; Hinton, David A.; Stuever, Robert A.; [1996]; 9 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The National Aeronautics and Space Administration (NASA) is addressing airport capacity enhancements during instrument meteorological conditions through the Terminal Area Productivity (TAP) program. Within TAP, the Reduced Spacing Operations (RSO) subelement at the NASA Langley Research Center is developing an Aircraft Vortex Spacing System (AVOSS). AVOSS will integrate the output of several inter-related areas to produce weather dependent, dynamic wake vortex spacing criteria. These areas include current and predicted weather conditions, models of wake vortex transport and decay in these weather conditions, real-time feedback of wake vortex behavior from sensors, and operationally acceptable aircraft/wake interaction criteria. In today's ATC system, the AVOSS could inform ATC controllers when a fixed reduced separation becomes safe to apply to large and heavy aircraft categories. With appropriate integration into the Center/TRACON Automation System (CTAS), AVOSS dynamic spacing could be tailored to actual generator/follower aircraft pairs rather than a few broad aircraft categories.
Author
Aircraft Approach Spacing; Aircraft Wakes; Vortices; NASA Programs; Research and Development; Systems Engineering

20040105626 NASA Langley Research Center, Hampton, VA, USA
Flight Test Validation of Optimal Input Design and Comparison to Conventional Inputs
Morelli, Eugene A.; [1997]; 13 pp.; In English
Report No.(s): AIAA Paper 97-3711; Copyright; Avail: CASI; A03, Hardcopy

A technique for designing optimal inputs for aerodynamic parameter estimation was flight tested on the F-18 High Angle of Attack Research Vehicle (HARV). Model parameter accuracies calculated from flight test data were compared on an equal basis for optimal input designs and conventional inputs at the same flight condition. In spite of errors in the a priori input design models and distortions of the input form by the feedback control system, the optimal inputs increased estimated parameter accuracies compared to conventional 3-2-1-1 and doublet inputs. In addition, the tests using optimal input designs demonstrated enhanced design flexibility, allowing the optimal input design technique to use a larger input amplitude to achieve further increases in estimated parameter accuracy without departing from the desired flight test condition. This work validated the analysis used to develop the optimal input designs, and demonstrated the feasibility and practical utility of the optimal input design technique.
Author
Flight Tests; Design Analysis; Optimization; Feedback Control

20040110232 NASA Langley Research Center, Hampton, VA, USA
Parametric Investigation of a High-Lift Airfoil at High Reynolds Numbers
Lin, John C.; Dominik, Chet J.; [1997]; 37 pp.; In English
Contract(s)/Grant(s): NAS1-18763; No Copyright; Avail: CASI; A03, Hardcopy

A new two-dimensional, three-element, advanced high-lift research airfoil has been tested in the NASA Langley Research Center s Low-Turbulence Pressure Tunnel at a chord Reynolds number up to 1.6 x 107. The components of this high-lift airfoil have been designed using a incompressible computational code (INS2D). The design was to provide high maximum-lift values while maintaining attached flow on the single-segment flap at landing conditions. The performance of the new NASA research airfoil is compared to a similar reference high-lift airfoil. On the new high-lift airfoil the effects of Reynolds number on slat and flap rigging have been studied experimentally, as well as the Mach number effects. The performance trend of the high-lift design is comparable to that predicted by INS2D over much of the angle-of-attack range. However, the code did not accurately predict the airfoil performance or the configuration-based trends near maximum lift where the compressibility effect could play a major role.
Author
Airfoils; Computer Programs; Flapping; Compressibility Effects

20040110233 NASA Langley Research Center, Hampton, VA, USA

Vertical Tail Buffeting Alleviation Using Piezoelectric Actuators: Some Results of the Actively Controlled Response of Buffet-Affected Tails (ACROBAT) Program

Moses, Robert W.; [1997]; 12 pp.; In English; SPIE's 4th Annual Symposium on Smart Structures and Materials, Industrial and Commercial Applications of Smart Structures Technologies, 4-6 Mar. 1997, San Diego, CA, USA; No Copyright; Avail: CASI; A03, Hardcopy

A 1/6-scale F-18 wind-tunnel model was tested in the Transonic Dynamics Tunnel at the NASA Langley Research Center as part of the Actively Controlled Response Of Buffet Affected Tails (ACROBAT) program to assess the use of active controls in reducing vertical tail buffeting. The starboard vertical tail was equipped with an active rudder and the port vertical tail was equipped with piezoelectric actuators. The tunnel conditions were atmospheric air at a dynamic pressure of 14 psf. By using single-input-single-output control laws at gains well below the physical limits of the actuators, the power spectral density of the root strains at the frequency of the first bending mode of the vertical tail was reduced by as much as 60 percent up to angles of attack of 37 degrees. Root mean square (RMS) values of root strain were reduced by as much as 19 percent. Buffeting alleviation results when using the rudder are presented for comparison. Stability margins indicate that a constant gain setting in the control law may be used throughout the range of angle of attack tested.

Author

Active Control; Buffeting; F-18 Aircraft; Piezoelectric Actuators; Tail Assemblies; Transonic Wind Tunnels; Wind Tunnel Models; Aeroelasticity

20040110243 NASA Langley Research Center, Hampton, VA, USA

Computation of Vortex Shedding and Radiated Sound for a Circular Cylinder

Cox, Jared S.; Brentner, Kenneth S.; Rumsey, Christopher L.; Younis, Bassam A.; [1997]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The Lighthill acoustic analogy approach combined with Reynolds-averaged Navier Stokes is used to predict the sound generated by unsteady viscous flow past a circular cylinder assuming a correlation length of ten cylinder diameters. The two-dimensional unsteady ow field is computed using two Navier-Stokes codes at a low Mach number over a range of Reynolds numbers from 100 to 5 million. Both laminar ow as well as turbulent ow with a variety of eddy viscosity turbulence models are employed. Mean drag and Strouhal number are examined, and trends similar to experiments are observed. Computing the noise within the Reynolds number regime where transition to turbulence occurs near the separation point is problematic: laminar flow exhibits chaotic behavior and turbulent ow exhibits strong dependence on the turbulence model employed. Comparisons of far-field noise with experiment at a Reynolds number of 90,000, therefore, vary significantly, depending on the turbulence model. At a high Reynolds number outside this regime, three different turbulence models yield self-consistent results.

Author

Circular Cylinders; Vortex Shedding; Unsteady Flow; Acoustics; Bluff Bodies; Computational Fluid Dynamics

20040110255 NASA Langley Research Center, Hampton, VA, USA

XV-15 Tiltrotor Low Noise Terminal Area Operations

Conner, David A.; Marcolini, Michael A.; Edwards, Bryan D.; Brieger, John T.; [1998]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Acoustic data have been acquired for the XV-15 tiltrotor aircraft performing a variety of terminal area operating procedures. This joint NASA/Bell/Army test program was conducted in two phases. During Phase 1 the XV-15 was flown over a linear array of microphones, deployed perpendicular to the flight path, at a number of fixed operating conditions. This documented the relative noise differences between the various conditions. During Phase 2 the microphone array was deployed over a large area to directly measure the noise footprint produced during realistic approach and departure procedures. The XV-15 flew approach profiles that culminated in IGE hover over a landing pad, then takeoffs from the hover condition back out over the microphone array. Results from Phase 1 identify noise differences between selected operating conditions, while those from Phase 2 identify differences in noise footprints between takeoff and approach conditions and changes in noise footprint due to variation in approach procedures.

Author

Low Noise; Tilt Rotor Aircraft; Xv-15 Aircraft; Airports; Flight Tests

20040110274 NASA Langley Research Center, Hampton, VA, USA

Future Flight Decks

Arbuckle, P. Douglas; Abbott, Kathy H.; Abbott, Terence S.; Schutte, Paul C.; [1998]; 13 pp.; In English; 21st Congress International Council of the Aeronautical Sciences, 13-17 Sep. 1998, Melbourne, Australia

Report No.(s): Paper-98-1.9.3; No Copyright; Avail: CASI; A03, Hardcopy

The evolution of commercial transport flight deck configurations over the past 20-30 years and expected future developments are described. Key factors in the aviation environment are identified that the authors expect will significantly affect flight deck designers. One of these is the requirement for commercial aviation accident rate reduction, which is probably required if global commercial aviation is to grow as projected. Other factors include the growing incrementalism in flight deck implementation, definition of future airspace operations, and expectations of a future pilot corps that will have grown up with computers. Future flight deck developments are extrapolated from observable factors in the aviation environment, recent research results in the area of pilot-centered flight deck systems, and by considering expected advances in technology that are being driven by other than aviation requirements. The authors hypothesize that revolutionary flight deck configuration changes will be possible with development of human-centered flight deck design methodologies that take full advantage of commercial and/or entertainment-driven technologies.

Author

Commercial Aircraft; Aircraft Configurations; Aircraft Compartments; Aeronautical Engineering

20040110305 NASA Langley Research Center, Hampton, VA, USA

Multi-Body Analysis of a Tiltrotor Configuration

Ghiringhelli, G. L.; Masarati, P.; Mantegazza, P.; Nixon, M. W.; [1997]; 31 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The paper describes the aeroelastic analysis of a tiltrotor configuration. The 1/5 scale wind tunnel semispan model of the V-22 tiltrotor aircraft is considered. The analysis is performed by means of a multi-body code, based on an original formulation. The differential equilibrium problem is stated in terms of first order differential equations. The equilibrium equations of every rigid body are written, together with the definitions of the momenta. The bodies are connected by kinematic constraints, applied in form of Lagrangian multipliers. Deformable components are mainly modelled by means of beam elements, based on an original finite volume formulation. Multi-disciplinar problems can be solved by adding user-defined differential equations. In the presented analysis the equations related to the control of the swash-plate of the model are considered. Advantages of a multi-body aeroelastic code over existing comprehensive rotorcraft codes include the exact modelling of the kinematics of the hub, the detailed modelling of the flexibility of critical hub components, and the possibility to simulate steady flight conditions as well as wind-up and maneuvers. The simulations described in the paper include: 1) the analysis of the aeroelastic stability, with particular regard to the proprotor/pylon instability that is peculiar to tiltrotors, 2) the determination of the dynamic behavior of the system and of the loads due to typical maneuvers, with particular regard to the conversion from helicopter to airplane mode, and 3) the stress evaluation in critical components, such as the pitch links and the conversion downstop spring.

Author

Aeroelasticity; Tilt Rotor Aircraft; Wind Tunnel Models; Finite Volume Method; Equilibrium Equations; Dynamic Characteristics; Deformation

20040110324 NASA Langley Research Center, Hampton, VA, USA

The NASA B-757 HIRF Test Series: Flight Test Results

Moeller, Karl J.; Dudley, Kenneth L.; [1997]; 7 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

In 1995, the NASA Langley Research Center conducted a series of aircraft tests aimed at characterizing the electromagnetic environment (EME) in and around a Boeing 757 airliner. Measurements were made of the electromagnetic energy coupled into the aircraft and the signals induced on select structures as the aircraft was flown past known RF transmitters. These measurements were conducted to provide data for the validation of computational techniques for the assessment of electromagnetic effects in commercial transport aircraft. This paper reports on the results of flight tests using RF radiators in the HF, VHF, and UHF ranges and on efforts to use computational and analytical techniques to predict RF field levels inside the airliner at these frequencies.

Author

Flight Tests; Electromagnetic Environment Experiment; Electromagnetic Fields

20040110340 NASA Langley Research Center, Hampton, VA, USA

Aerodynamic Shape Optimization Based on Free-form Deformation

Samareh, Jamshid A.; July 26, 2004; 12 pp.; In English; 10th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, 30 Aug. - 1 Sep. 2004, Albany, NY, USA

Contract(s)/Grant(s): 762-45-CG; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents a free-form deformation technique suitable for aerodynamic shape optimization. Because the proposed technique is independent of grid topology, we can treat structured and unstructured computational fluid dynamics grids in the same manner. The proposed technique is an alternative shape parameterization technique to a trivariate volume technique. It retains the flexibility and freedom of trivariate volumes for CFD shape optimization, but it uses a bivariate surface representation. This reduces the number of design variables by an order of magnitude, and it provides much better control for surface shape changes. The proposed technique is simple, compact, and efficient. The analytical sensitivity derivatives are independent of the design variables and are easily computed for use in a gradient-based optimization. The paper includes the complete formulation and aerodynamics shape optimization results.

Author

Computational Fluid Dynamics; Deformation; Shape Optimization; Aerodynamic Configurations; Parameterization

20040110341 Army Aviation Systems Command, Hampton, VA, USA

A Comparison of Interactional Aerodynamics Methods for a Helicopter in Low Speed Flight

Berry, John D.; Letnikov, Victor; Bavykina, Irena; Chaffin, Mark S.; [1997]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Recent advances in computing subsonic flow have been applied to helicopter configurations with various degrees of success. This paper is a comparison of two specific methods applied to a particularly challenging regime of helicopter flight, very low speeds, where the interaction of the rotor wake and the fuselage are most significant. Comparisons are made between different methods of predicting the interactional aerodynamics associated with a simple generic helicopter configuration. These comparisons are made using fuselage pressure data from a Mach-scaled powered model helicopter with a rotor diameter of approximately 3 meters. The data shown are for an advance ratio of 0.05 with a thrust coefficient of 0.0066. The results of this comparison show that in this type of complex flow both analytical techniques have regions where they are more accurate in matching the experimental data.

Author

Low Speed; Wind Tunnel Tests; Aerodynamic Configurations; Interactional Aerodynamics; Rotary Wing Aircraft

20040110349 NASA Langley Research Center, Hampton, VA, USA

Comparison of Rolling Moment Characteristics During Roll Oscillations for a Low and a High Aspect Ratio Configuration

Brandon, Jay M.; Foster, John V.; Shah, Gautam H.; Gato, William; Wilborn, James E.; [2004]; 10 pp.; In English; AIAA Atmospheric Flight Mechanics Conference, 16-19 Aug. 2004, Providence, RI, USA

Contract(s)/Grant(s): 762-45-DB

Report No.(s): AIAA Paper 2004-5273; Copyright; Avail: CASI; A02, Hardcopy

Improvements in testing and modeling of nonlinear and unsteady aerodynamic effects for flight dynamics predictions of vehicle performance is critical to enable the design and implementation of new, innovative vehicle concepts. Any configuration which exhibits significant flow separation, nonlinear aerodynamics, control interactions or attempts maneuvering through one or more conditions such as these is, at present, a challenge to test, model or predict flight dynamic responses prior to flight. Even in flight test experiments, adequate models are not available to study and characterize the complex nonlinear and time-dependent flow effects occurring during portions of the maneuvering envelope. Traditionally, airplane designs have been conducted to avoid these areas of the flight envelope. Better understanding and characterization of these flight regimes may not only reduce risk and cost of flight test development programs, but also may pave the way for exploitation of those characteristics that increase airplane capabilities. One of the hurdles is that the nonlinear/unsteady effects appear to be configuration dependent. This paper compares some of the dynamic aerodynamic stability characteristics of two very different configurations - representative of a fighter and a transport airplane - during dynamic body-axis roll wind tunnel tests. The fighter model shows significant effects of oscillation frequency which are not as apparent for the transport configuration.

Author

Aerodynamic Stability; Mathematical Models; Nonlinearity; Flight Envelopes; High Aspect Ratio; Unsteady Aerodynamics; Dynamic Stability

20040110391 NASA Langley Research Center, Hampton, VA, USA
Rotorcraft Noise Model
Lucas, Michael J.; Marcolini, Michael A.; [1997]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The Rotorcraft Noise Model (RNM) is an aircraft noise impact modeling computer program being developed for NASA-Langley Research Center which calculates sound levels at receiver positions either on a uniform grid or at specific defined locations. The basic computational model calculates a variety of metria. Acoustic properties of the noise source are defined by two sets of sound pressure hemispheres, each hemisphere being centered on a noise source of the aircraft. One set of sound hemispheres provides the broadband data in the form of one-third octave band sound levels. The other set of sound hemispheres provides narrowband data in the form of pure-tone sound pressure levels and phase. Noise contours on the ground are output graphically or in tabular format, and are suitable for inclusion in Environmental Impact Statements or Environmental Assessments.
Author
Rotary Wing Aircraft; Aircraft Noise; Aircraft Models; Computer Programs

20040110392 NASA Langley Research Center, Hampton, VA, USA
Active Vertical Tail Buffeting Alleviation on a Twin-Tail Fighter Configuration in a Wind Tunnel
Moses, Robert W.; [1997]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A 1/6-scale F-18 wind-tunnel model was tested in the Transonic Dynamics Tunnel at the NASA Langley Research Center as part of the Actively Controlled Response Of Buffet-Affected Tails (ACROBAT) program to assess the use of active controls in reducing vertical tail buffeting. The starboard vertical tail was equipped with an active rudder and other aerodynamic devices, and the port vertical tail was equipped with piezoelectric actuators. The tunnel conditions were atmospheric air at a dynamic pressure of 14 psf. By using single-input-single-output control laws at gains well below the physical limits of the control effectors, the power spectral density of the root strains at the frequency of the first bending mode of the vertical tail was reduced by as much as 60 percent up to angles of attack of 37 degrees. Root mean square (RMS) values of root strain were reduced by as much as 19 percent. Stability margins indicate that a constant gain setting in the control law may be used throughout the range of angle of attack tested.
Author
Buffeting; F-18 Aircraft; Tail Assemblies; Transonic Wind Tunnels; Wind Tunnel Models; Active Control

20040110397 NASA Langley Research Center, Hampton, VA, USA
Fluidic Thrust Vectoring of an Axisymmetric Exhaust Nozzle at Static Conditions
Wing, David J.; Giuliano, Victor J.; [1997]; 6 pp.; In English; 1997 ASME Fluids Engineering Division Summer Meeting (FEDSM'97), 22-26 Jun. 1997, USA
Report No.(s): DWSAM97-3228; Copyright; Avail: CASI; A02, Hardcopy

A sub-scale experimental static investigation of an axisymmetric nozzle with fluidic injection for thrust vectoring was conducted at the NASA Langley Jet Exit Test Facility. Fluidic injection was introduced through flush-mounted injection ports in the divergent section. Geometric variables included injection-port geometry and location. Test conditions included a range of nozzle pressure ratios from 2 to 10 and a range of injection total pressure ratio from no-flow to 1.5. The results indicate that fluidic injection in an axisymmetric nozzle operating at design conditions produced significant thrust-vector angles with less reduction in thrust efficiency than that of a fluidically-vectored rectangular jet. The axisymmetric geometry promoted a pressure relief mechanism around the injection slot, thereby reducing the strength of the oblique shock and the losses associated with it. Injection port geometry had minimal effect on thrust vectoring.
Author
Exhaust Nozzles; Fluidics; Symmetry; Thrust Vector Control; Nozzle Design; Static Tests; Test Facilities

20040110400 NASA Langley Research Center, Hampton, VA, USA
Higher Harmonic Control for Tiltrotor Vibration Reduction
Nixon, Mark W.; Kvaternik, Raymond G.; Settle, T. Ben; [1997]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The results of a joint NASA/Army/Bell Helicopter Textron wind-tunnel test to assess the potential of higher harmonic control (HHC) for reducing vibrations in tiltrotor aircraft operating in the airplane mode of flight, and to evaluate the effectiveness of a Bell-developed HHC algorithm called MAVSS (Multipoint Adaptive Vibration Suppression System) are presented. The test was conducted in the Langley Transonic Dynamics Tunnel using an unpowered 1/5- scale semispan aeroelastic model of the V-22 which was modified to incorporate an HHC system employing both the rotor swashplate and

the wing flaperon. The effectiveness of the swashplate and the flaperon acting either singly or in combination in reducing 1P and 3P wing vibrations over a wide range of tunnel airspeeds and rotor rotational speeds was demonstrated. The MAVSS algorithm was found to be robust to variations in tunnel airspeed and rotor speed, requiring only occasion-al on-line recalculations of the system transfer matrix.
Author
Aeroelasticity; Harmonic Control; Semispan Models; Vibration Damping; Wind Tunnel Tests; Bell Aircraft; Tilt Rotor Aircraft

20040110402 NASA Langley Research Center, Hampton, VA, USA
A Comparison of Computational Aeroacoustic Prediction Methods for Transonic Rotor Noise
Brentner, Kenneth S.; Lyrintzis, Anastasios; Koutsavdis, Evangelos K.; [1996]; 12 pp.; In English; American Helicopter Society 52nd Annual Forum, Jun. 1996, Washington, DC, USA; No Copyright; Avail: CASI; A03, Hardcopy

This paper compares two methods for predicting transonic rotor noise for helicopters in hover and forward flight. Both methods rely on a computational fluid dynamics (CFD) solution as input to predict the acoustic near and far fields. For this work, the same full-potential rotor code has been used to compute the CFD solution for both acoustic methods. The first method employs the acoustic analogy as embodied in the Ffowcs Williams-Hawkings (FW-H) equation, including the quadrupole term. The second method uses a rotating Kirchhoff formulation. Computed results from both methods are compared with one other and with experimental data for both hover and advancing rotor cases. The results are quite good for all cases tested. The sensitivity of both methods to CFD grid resolution and to the choice of the integration surface/volume is investigated. The computational requirements of both methods are comparable; in both cases these requirements are much less than the requirements for the CFD solution.
Author
Aeroacoustics; Computational Fluid Dynamics; Rotor Aerodynamics; Transonic Flow; Tilt Rotor Aircraft

20040110412 NASA Langley Research Center, Hampton, VA, USA
Velocity Measurements Near the Empennage of a SmallScale Helicopter Model
Gorton, Susan Althoff; Meyers, James F.; Berry, John D.; [1996]; 15 pp.; In English; American Helicopter Society 52nd Annual Forum, 4-6 Jun. 1996, Washington, DC, USA; No Copyright; Avail: CASI; A03, Hardcopy

A test program was conducted in the NASA Langley 14- by 22-Foot Subsonic Tunnel to measure the flow near the empennage of a small-scale powered helicopter model with an operating tail fan. Three-component velocity profiles were measured with Laser Velocimetry (LV) one chord forward of the horizontal tail for four advance ratios to evaluate the effect of the rotor wake impingement on the horizontal tail angle of attack. These velocity data indicate the horizontal tail can experience unsteady downwash angle variations of over 30 degrees due to the rotor wake influence. The horizontal tail is most affected by the rotor wake above advance ratios of 0.10. Velocity measurements of the flow on the inlet side of the fan were made for a low-speed flight condition using both conventional LV techniques and a promising, non-intrusive, global, three-component velocity measurement technique called Doppler Global Velocimetry (DGV). The velocity data show an accelerated flow near the fan duct, and vorticity calculations track the passage of main rotor wake vortices through the measurement plane. DGV shows promise as an evolving tool for rotor flowfield diagnostics.
Author
Tail Assemblies; Subsonic Wind Tunnels; Velocity Measurement; Aircraft Models; Horizontal Tail Surfaces; Helicopter Design

20040110414 NASA Langley Research Center, Hampton, VA, USA
Validation of a Numerical Method for Determining Liner Impedance
Watson, Willie R.; Jones, Michael G.; Tanner, Sharon E.; Parrott, Tony L.; [1996]; 20 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This paper reports the initial results of a test series to evaluate a method for determining the normal incidence impedance of a locally reacting acoustically absorbing liner, located on the lower wall of a duct in a grazing incidence, multi-modal, non-progressive acoustic wave environment without flow. This initial evaluation is accomplished by testing the methods' ability to converge to the known normal incidence impedance of a solid steel plate, and to the normal incidence impedance of an absorbing test specimen whose impedance was measured in a conventional normal incidence tube. The method is shown to converge to the normal incident impedance values and thus to be an adequate tool for determining the impedance of specimens in a grazing incidence, multi-modal, nonprogressive acoustic wave environment for a broad range of source frequencies.
Author
Numerical Analysis; Aeroacoustics; Commercial Aircraft; Acoustic Impedance; Linings

20040110416 NASA Langley Research Center, Hampton, VA, USA

Aeroelastic Analysis of Helicopter Rotor Blades Incorporating Anisotropic Piezoelectric Twist Actuation

Wilkie, W. Keats; Belvin, W. Keith; Park, K. C.; [1996]; 11 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

A simple aeroelastic analysis of a helicopter rotor blade incorporating embedded piezoelectric fiber composite, interdigitated electrode blade twist actuators is described. The analysis consists of a linear torsion and flapwise bending model coupled with a nonlinear ONERA based unsteady aerodynamics model. A modified Galerkin procedure is performed upon the rotor blade partial differential equations of motion to develop a system of ordinary differential equations suitable for dynamics simulation using numerical integration. The twist actuation responses for three conceptual fullscale blade designs with realistic constraints on blade mass are numerically evaluated using the analysis. Numerical results indicate that useful amplitudes of nonresonant elastic twist, on the order of one to two degrees, are achievable under one-g hovering flight conditions for interdigitated electrode poling configurations. Twist actuation for the interdigitated electrode blades is also compared with the twist actuation of a conventionally poled piezoelectric fiber composite blade. Elastic twist produced using the interdigitated electrode actuators was found to be four to five times larger than that obtained with the conventionally poled actuators.
Author

Aeroelasticity; Anisotropy; Piezoelectricity; Rotor Blades (Turbomachinery); Twisting; Actuators

20040110434 NASA Langley Research Center, Hampton, VA, USA

Titanium Alloys and Processing for High Speed Aircraft

Brewer, William D.; Bird, R. Keith; Wallace, Terryl A.; [1996]; 7 pp.; In English

Contract(s)/Grant(s): NAS1-20220; No Copyright; Avail: CASI; A02, Hardcopy

Commercially available titanium alloys as well as emerging titanium alloys with limited or no production experience are being considered for a variety of applications to high speed commercial aircraft structures. A number of government and industry programs are underway to improve the performance of promising alloys by chemistry and/or processing modifications and to identify appropriate alloys and processes for specific aircraft structural applications. This paper discusses some of the results on the effects of heat treatment, service temperatures from - 54 C to +177 C, and selected processing on the mechanical properties of several candidate beta and alpha-beta titanium alloys. Included are beta alloys Timetal 21S, LCB, Beta C, Beta CEZ, and Ti-10-2-3 and alpha-beta alloys Ti-62222, Ti-6242S, Timetal 550, Ti-62S, SP-700, and Corona-X. The emphasis is on properties of rolled sheet product form and on the superplastic properties and processing of the materials.
Author

Titanium Alloys; Aircraft Structures; Mechanical Properties; Heat Treatment

20040110491 Air Command and Staff Coll., Maxwell AFB, AL

RNZAF C-130 Simulator Training: The Future of a Costly Necessity

Davies, Tony; Apr. 2000; 57 pp.; In English; Original contains color illustrations

Report No.(s): AD-A425315; AU/ACSC/00-051/2000-04; No Copyright; Avail: CASI; A04, Hardcopy

This paper aims to assist the RNZAF in realizing that some long-term strategic decisions are required about the future of its C-130 training. At present, there exists a distributed trend showing pilot experience, aircraft continuation training, and simulator refresher training to be decreasing insidiously. Most of this is due to budgetary constraints, which have reduced resources to a bare minimum. The current simulator-training scheme is too expensive to yield the required minimum frequency for refresher training and new ways must be identified to enable more training for less cost. This paper reviews the rational for using field simulators and then compares the RNZAF with other air forces to assess whether its C-130 pilots are fulfilling the minimum level of simulator training recommended by those countries. It examines options for increasing the frequency and quantity of flight simulator training then makes recommendations regarding the future of RNZAF C-130 simulator training. The remainder of this abstract provides a basic overview of the current simulator situation.
DTIC

Flight Simulators; Flight Training; Simulators

20040110669 NASA Langley Research Center, Hampton, VA, USA

Hyper-X: Flight Validation of Hypersonic Airbreathing Technology

Rausch, Vincent L.; McClinton, Charles R.; Crawford, J. Larry; [1997]; 7 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

This paper provides an overview of NASA's focused hypersonic technology program, i.e. the Hyper-X program. This program is designed to move hypersonic, air breathing vehicle technology from the laboratory environment to the flight

environment, the last stage preceding prototype development. This paper presents some history leading to the flight test program, research objectives, approach, schedule and status. Substantial experimental data base and concept validation have been completed. The program is concentrating on Mach 7 vehicle development, verification and validation in preparation for wind tunnel testing in 1998 and flight testing in 1999. It is also concentrating on finalization of the Mach 5 and 10 vehicle designs. Detailed evaluation of the Mach 7 vehicle at the flight conditions is nearing completion, and will provide a data base for validation of design methods once flight test data are available.
Author
Air Breathing Engines; Flight Tests; Hypersonic Vehicles; Wind Tunnel Tests; Technology Utilization; NASA Programs; Research Vehicles

20040110716 NASA Langley Research Center, Hampton, VA, USA
Modeling of Sound Transmission through Shell Structures with Turbulent Boundary Layer Excitation
Silcox, Richard J.; Robinson, Jay H.; Tang, Yvette Y.; [1997]; 7 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The turbulent boundary layer (TBL) pressure field is an important source of cabin noise during cruise of high subsonic and supersonic commercial aircraft. The broadband character of this excitation field results in an interior noise spectrum that dominates the overall sound pressure level (SPL) and speech interference metrics in the forward and midcabins of many aircraft. In the authors' previous study, sound transmission through an aircraft fuselage, modeled by two concentric cylindrical sandwich shells and excited by a TBL statistical model was investigated analytically. An assessment of point and global structural vibration levels and resulting interior noise levels was obtained for different TBL models, flight conditions and fuselage structural designs. However, due to the complication of the shell structure, the important noise transmission mechanisms were difficult to discern. Previous experience has demonstrated that a fundamental understanding of the range of modes (or wavenumbers) generated by the TBL source both in the structure and the acoustic cavity is key to the development of both active and passive control technologies. In an initial effort to provide this insight, the objective of this paper is to develop an analytical model of sound transmission through a simple unstiffened cylindrical aluminum shell excited by a TBL pressure field. The description of the turbulent pressure field is based on the Corcos formulation for the cross-spectral density (CSD) of the pressure fluctuations. The coupled shell and interior and exterior acoustic equations are solved for the structural displacement and the interior acoustic response using a Galerkin approach to obtain analytical solutions. Specifically, this study compares the real part of the normalized CSD of the TBL excitation field, the structural displacement and the interior acoustic field. Further the modal compositions of the structural and cavity response are examined and some inference of the dominant mechanism of noise transmission is made.
Derived from text
Mathematical Models; Sound Transmission; Turbulent Boundary Layer; Commercial Aircraft; Supersonic Aircraft; Cylindrical Shells; Mechanical Properties

20040110721 Lockheed Martin Engineering and Sciences Co., Hampton, VA, USA
Parameter Identification Flight Test Maneuvers for Closed Loop Modeling of the F-18 High Alpha Research Vehicle (HARV)
Batterson, James G., Technical Monitor; Morelli, E. A.; May 1996; 36 pp.; In English
Contract(s)/Grant(s): NAS1-19000; WU 505-64-52-01
Report No.(s): NASA-CR-198269; No Copyright; Avail: CASI; A03, Hardcopy

Flight test maneuvers are specified for the F-18 High Alpha Research Vehicle (HARV). The maneuvers were designed for closed loop parameter identification purposes, specifically for longitudinal and lateral linear model parameter estimation at 5,20,30,45, and 60 degrees angle of attack, using the Actuated Nose Strakes for Enhanced Rolling (ANSER) control law in Thrust Vectoring (TV) mode. Each maneuver is to be realized by applying square wave inputs to specific pilot station controls using the On-Board Excitation System (OBES). Maneuver descriptions and complete specifications of the time / amplitude points defining each input are included, along with plots of the input time histories.
Author
F-18 Aircraft; Flight Tests; Maneuvers; Parameter Identification; Research Vehicles; Feedback Control; Wind Tunnel Tests

20040110732 Federal Aviation Administration, Washington, DC
Aircraft Wiring Harness Shield Degradation Study
Aug. 2004; In English
Report No.(s): PB2004-106667; DOT/FAA/AR-04/12; No Copyright; Avail: National Technical Information Service (NTIS)

The shielding on wire bundles contributes significantly towards an aircrafts continued airworthiness by maintaining electromagnetic protection over the lifetime of an aircraft. This study was conducted to examine the degradation effects on the electrical characteristics of the aircraft wiring harness shielding due to aircraft aging and exposure to environmental conditions. Harness shield loop resistance can be an important indicator of the quality of the electrical bonds between the cable shield, backshells, connectors, and metallic structures. This study was also done to compare loop resistance measurement with visual inspection, to predict or identify unsafe conditions for the aircraft, and to determine whether loop resistance measurements are adequate to detect shield degradation or if swept-frequency measurements are also required.
NTIS
Wiring; Aircraft Reliability; Harnesses

20040110734 Textron Bell Helicopter, Fort Worth, TX, USA
Hazard Assessment for Usage Credits on Helicopters Using Health and Usage Monitoring System
Augustin, M.; Jul. 2004; 70 pp.; In English
Report No.(s): PB2004-106669; No Copyright; Avail: CASI; A04, Hardcopy

A rotorcraft Health and Usage Monitoring System (HUMS) has two important roles. First, by accounting for maneuvers and conditions that are more severe than those that the aircraft was designed for, premature fatigue and other types of failures that could be catastrophic can be avoided. Second, by obtaining credit for service that is less demanding than those for which the aircraft was certified, longer service times can be justified, which will allow more economical operations. However, while usage monitoring has prevented failures, to date, no applicants have successfully followed the guidance of the Federal Aviation Administration Advisory Circular (AC) to develop individual aircraft usage credits. This report collects data and other information that was developed by Bell Helicopter Textron for its HUMS applications and provides it in a systematic manner to support more general and informed use of this important technology by its incorporation into the AC. A detailed overview of the HUMS methodology is provided in this report that describes how flight condition recognition is used to determine an individual aircraft load spectrum that, in turn, is used to calculate the effective hours that correspond to this usage. The report then focuses on sources of error in usage monitoring and how these can be overcome. These include inaccurate data, missing data, and incorrect algorithms. Next, system compliance with usage applications is discussed. Finally, a prototype usage system for implementing and using HUMS is outlined, which has been evaluated for compliance with the HUMS AC. This analysis verified that the prototype system and its architecture are compliant with the intent of the AC, including required parameter rates and accuracy levels. This report provides a valuable resource for usage monitoring that can both increase safety and enhance more economical operations, while also providing the basis for the eventual linkage of HUMS with the rotorcraft damage tolerance methodology.
NTIS
Helicopters; Systems Health Monitoring

20040110735 Wichita State Univ., Wichita, KS, USA
General Aviation Lightning Strike Report and Protection Level Study
O'Loughlin, J. B.; Skinner, S. R.; Aug. 2004; 36 pp.; In English
Report No.(s): PB2004-106668; No Copyright; Avail: CASI; A03, Hardcopy

This report analyzed 95 lightning strike reports from general aviation business jet aircraft that occurred over a 5-year period. The analyses was conducted to determine which variables most affect the severity of indirect lightning effects damage of in-service aircraft and their systems and to assess the effect of the level of lightning and High-Intensity Radiated Fields (HIRF) protection design and implementation.
NTIS
General Aviation Aircraft; Lightning; Electromagnetic Fields; Aircraft Reliability

20040110736 Federal Aviation Administration, Washington, DC
Limiting Oxygen Concentration Required to Inert Jet Fuel Vapors Existing at Reduced Fuel Tank Pressures, Final Phase
Aug. 2004; In English
Report No.(s): PB2004-106666; DOT/FAA/AR-04/8; No Copyright; Avail: National Technical Information Service (NTIS)

This report discusses experiments to determine the reduction in oxygen concentration required to prevent a fuel tank explosion. A simulated aircraft fuel tank containing JP-8 fuel of an amount equivalent to a mass loading of approximately 4.5 kg/m3 was used to determine the limiting oxygen concentration (LOC) at pressures corresponding to altitudes ranging from

0 to 38,000 feet. In addition, the peak pressure rise was measured at various altitudes (pressures) due to ignition occurring at O(2) levels approximately 1% to 1. 5% above the LOC.
NTIS
Fuel Tanks; Jet Engine Fuels; Aircraft Fuels

20040110811 NASA Langley Research Center, Hampton, VA, USA
Controlled Aeroelastic Response and Airfoil Shaping Using Adaptive Materials and Integrated Systems
Pinkerton, Jennifer L.; McGowan, Anna-Maria R.; Moses, Robert W.; Scott, Robert C.; Heeg, Jennifer; [1996]; 13 pp.; In English; SPIE's 1996 Symposium on Smart Structures and Integrated Systems, 26-29 Feb. 1996, San Diego, CA, USA; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents an overview of several activities of the Aeroelasticity Branch at the NASA Langley Research Center in the area of applying adaptive materials and integrated systems for controlling both aircraft aeroelastic response and airfoil shape. The experimental results of four programs are discussed: the Piezoelectric Aeroelastic Response Tailoring Investigation (PARTI); the Adaptive Neural Control of Aeroelastic Response (ANCAR) program; the Actively Controlled Response of Buffet Affected Tails (ACROBAT) program; and the Airfoil THUNDER Testing to Ascertain Characteristics (ATTACH) project. The PARTI program demonstrated active flutter control and significant rcductions in aeroelastic response at dynamic pressures below flutter using piezoelectric actuators. The ANCAR program seeks to demonstrate the effectiveness of using neural networks to schedule flutter suppression control laws. Th,e ACROBAT program studied the effectiveness of a number of candidate actuators, including a rudder and piezoelectric actuators, to alleviate vertical tail buffeting. In the ATTACH project, the feasibility of using Thin-Layer Composite-Uimorph Piezoelectric Driver and Sensor (THUNDER) wafers to control airfoil aerodynamic characteristics was investigated. Plans for future applications are also discussed.
Author
Aeroelasticity; Piezoelectric Actuators; Active Control; Airfoils; Wind Tunnel Tests

20040110821 Georgia Inst. of Tech., Atlanta, GA, USA
A Tool For Design Minimization Of Aircraft Interior Noise
Cunefare, Kenneth A.; Crane, Scott P.; Engelstad, Stephen P.; Powell, Eugene A.; [1996]; 7 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The design and development of new generations of aircraft of all classes continues apace. Increasingly, the quality of the interior acoustic environment of such new aircraft is becoming of greater importance. A need exists, then, to address the integration of acoustic considerations into the aircraft design process. To address this need, a computational design tool was developed to perform a constrained optimization of the acoustic environment within a vibrating cylinder, incorporating finite element and boundary element methods. The tool comprises a UNIX shell script that coordinates an iterative design optimization process integrating a number of programs, the key components of which are: NASTRAN for structural analyses; COMET/Acoustics for acoustic analyses; and CONMIN for nonlinear optimization. In addition to the structure and implementation of the tool, this paper presents the results of a number of trials of the tool applied to unstiffened cylinders, considering different formulations of the objective function to be optimized. The results presented here are principally directed toward tonal noise components within turbo-prop driven aircraft.
Author
Aircraft Noise; Design Optimization; Turboprop Aircraft; Computer Programs; Mathematical Models

20040110838 NASA Glenn Research Center, Cleveland, OH, USA
A Subsonic Aircraft Design Optimization With Neural Network and Regression Approximators
Patnaik, Surya N.; Coroneos, Rula M.; Guptill, James D.; Hopkins, Dale A.; Haller, William J.; August 2004; 25 pp.; In English; 10th Multidisciplinary Analysis and Optimization Conference, 30 Aug. - 1 Sep. 2004, Albany, NY, USA
Contract(s)/Grant(s): WBS 22-708-24-05
Report No.(s): NASA/TM-2004-213059; AIAA Paper 2004-4606; E-14504; No Copyright; Avail: CASI; A03, Hardcopy

The Flight-Optimization-System (FLOPS) code encountered difficulty in analyzing a subsonic aircraft. The limitation made the design optimization problematic. The deficiencies have been alleviated through use of neural network and regression approximations. The insight gained from using the approximators is discussed in this paper. The FLOPS code is reviewed. Analysis models are developed and validated for each approximator. The regression method appears to hug the data points, while the neural network approximation follows a mean path. For an analysis cycle, the approximate model required milliseconds of central processing unit (CPU) time versus seconds by the FLOPS code. Performance of the approximators was

satisfactory for aircraft analysis. A design optimization capability has been created by coupling the derived analyzers to the optimization test bed CometBoards. The approximators were efficient reanalysis tools in the aircraft design optimization. Instability encountered in the FLOPS analyzer was eliminated. The convergence characteristics were improved for the design optimization. The CPU time required to calculate the optimum solution, measured in hours with the FLOPS code was reduced to minutes with the neural network approximation and to seconds with the regression method. Generation of the approximators required the manipulation of a very large quantity of data. Design sensitivity with respect to the bounds of aircraft constraints is easily generated.
Author
Aircraft Design; Design Optimization; Neural Nets; Approximation; Subsonic Speed; Regression Coefficients

20040110861 NASA Langley Research Center, Hampton, VA, USA
Performance of Optimized Actuator and Sensor Arrays in an Active Noise Control System
Palumbo, D. L.; Padula, S. L.; Lyle, K. H.; Cline, J. H.; Cabell, R. H.; [1996]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Experiments have been conducted in NASA Langley s Acoustics and Dynamics Laboratory to determine the effectiveness of optimized actuator/sensor architectures and controller algorithms for active control of harmonic interior noise. Tests were conducted in a large scale fuselage model - a composite cylinder which simulates a commuter class aircraft fuselage with three sections of trim panel and a floor. Using an optimization technique based on the component transfer functions, combinations of 4 out of 8 piezoceramic actuators and 8 out of 462 microphone locations were evaluated against predicted performance. A combinatorial optimization technique call tabu search was employed to select the optimum transducer arrays. Three test frequencies represent the cases of a strong acoustic and strong structural response, a weak acoustic and strong structural response and a strong acoustic and weak structural response. Noise reduction was obtained using a Time Averaged/Gradient Descent (TAGD) controller. Results indicate that the optimization technique successfully predicted best and worst case performance. An enhancement of the TAGD control algorithm was also evaluated. The principal components of the actuator/sensor transfer functions were used in the PC-TAGD controller. The principal components are shown to be independent of each other while providing control as effective as the standard TAGD.
Author
Active Control; Actuators; Optimization; Sensors; Aircraft Noise; Arrays; Control Systems Design

20040110875 NASA Langley Research Center, Hampton, VA, USA
Aeroservoelastic Simulation of an Active Flexible Wing Wind Tunnel Model
Buttrill, Carey S.; Bacon, Barton J.; Heeg, Jennifer; Houck, Jacob A.; Wood, David V.; April 1996; 60 pp.; In English
Contract(s)/Grant(s): WU 505-64-52-01
Report No.(s): NASA-TP-3510; L-17276; No Copyright; Avail: CASI; A04, Hardcopy

Mathematical models and implementation issues are described for simulations developed in the active flexible wing wind tunnel test program, which resulted in successful application of active flutter control. The wind tunnel test program required a truth batch simulation for off-line tests of proposed control designs and functional, hotbench tests of digital controller hardware and software. To provide the hot-bench test environment, a real-time simulation of the wind tunnel model and test environment was desired. Although mathematical model complexity and computing power limitations prevented attainment of real-time operation, essential test goals were met with a hotbench simulation running at a timescale ratio no slower than 1:5. To achieve the required timescale, model reduction methods were applied to the aeroservoelastic portion of the full-order mathematical model. The reduction method was based on the internally balanced realization of a linear dynamic system. The error-bound properties of the internally balanced realization contributed to the method utility in the model reduction process. The state dimensions of the aeroservoelastic model were reduced by a factor of 2. The errors due to reduction appeared beyond the 10th bit of the analog-to-digital converters for all 560 combinations of simulation inputs and outputs.
Author
Aeroservoelasticity; Active Control; Computerized Simulation; Wind Tunnel Models; Flexible Wings

20040110892 NASA Langley Research Center, Hampton, VA, USA
Response of a Panel Structure Forced by the Noise from a Nearly Sonic Jet
Fenno, C. C., Jr.; Bayliss, A.; Maestrello, L.; January 2004; 10 pp.; In English
Contract(s)/Grant(s): NAS1-18605; NAS1-19480; NSF DMS-93-01635; No Copyright; Avail: CASI; A02, Hardcopy

A model of a high subsonic jet with a nearby array of exible, aircraft-type panels is studied numerically in two dimensions.

The jet is excited by a limited duration, spatially localized starter pulse in the potential core. The long time evolution of unsteady disturbances in the jet, the responses of the panels and the ensuing radiation are computed. The results show that the spectral response of both the jet and the panels is concentrated in a relatively narrow frequency band centered at a Strouhal number (based on jet exit velocity) of approximately 0.25 and associated harmonics. The loading on the panels generally increases with downstream distance. Panel radiation is weakest in upstream directions. Interior zones of silence, due to destructive interference of radiation from the panels, are observed.
Author
Panels; Subsonic Aircraft; Jet Aircraft Noise; Numerical Analysis; Free Jets

20040110897 NASA Langley Research Center, Hampton, VA, USA
Comparative Flow Path Analysis and Design Assessment of an Axisymmetric Hydrogen Fueled Scramjet Flight Test Engine at a Mach Number of 6.5
McClinton, C.; Rondakov, A.; Semenov, V.; Kopehenov, V.; [1991]; 15 pp.; In English
Contract(s)/Grant(s): NAS1-19864; NAS1-19000; Copyright; Avail: CASI; A03, Hardcopy

NASA has contracted with the Central Institute of Aviation Motors CIAM to perform a flight test and ground test and provide a scramjet engine for ground test in the USA. The objective of this contract is to obtain ground to flight correlation for a supersonic combustion ramjet (scramjet) engine operating point at a Mach number of 6.5. This paper presents results from a flow path performance and thermal evaluation performed on the design proposed by the CIAM. This study shows that the engine will perform in the scramjet mode for stoichiometric operation at a flight Mach number of 6.5. Thermal assessment of the structure indicates that the combustor cooling liner will provide adequate cooling for a Mach number of 6.5 test condition and that optional material proposed by CIAM for the cowl leading-edge design are required to allow operation with or without a type IV shock-shock interaction.
Author
Flow Characteristics; Design Analysis; Supersonic Combustion Ramjet Engines; Hypersonic Speed

20040110920 Ghent Univ., Belgium
Transition Modelling With the SST Turbulence Model and an Intermittency Transport Equation
Lodefier, K.; Merci, B.; DeLanghe, C.; Dick, E.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 584-601; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A transition model for describing bypass transition is presented based on the SST-model by Menter, with the k-omega part in low-Reynolds form according to Wilcox, and a dynamic equation for intermittency factor. This intermittency factor multiplies the turbulent viscosity computed by the turbulence model. Following a suggestion by Menter et al. [2002], the start of transition is computed based on local variables. For development of the model and testing, bypass transitional flows on adiabatic flat plates with sharp leading edges proposed by Clemson University (CU case) and by ERCOFTAC (T3 cases) have been used. Three zero pressure gradient test cases were considered (CU, T3A and T3B), and three with pressure distribution (T3C1, T3C2 and T3C5). After development, the model has been applied to two cascade test cases with a turbine profile of the Von Karman Institute (VKI), measured at the University of Genova. Reynolds number based on the chord for VKI1 is Re2c = 1600000 and for VKI2 Re2c = 590000. For the cascade test cases, a turbulent time scale bound has been applied according to Medic and Durbin [2002], in order to suppress excessive generation of turbulent kinetic energy at the leading edge. The intermittency equation is the one earlier used by Steelant and Dick [2001], but where the source term is multiplied with a starting function inspired by the one suggested by Menter et al. [2002]. This function is dependent on a local sensor for Re . The Mayle-correlation giving Re as function of the turbulence level Tu is used to estimate the transition value. The function is zero before start of transition and goes rapidly to 1 after transition. For flat plate experiments, Tu is the leading edge turbulence intensity. For cascades, the turbulence intensity at the boundary layer edge, just before the start of transition has been used. For the flat plate test cases, the correspondence with the experiments is very good except for the T3C2 case. The T3C cases all have an acceleration phase followed by a deceleration phase. For the T3C1 and T3C5 cases, transition occurs during the acceleration. For the T3C2 case, the acceleration is very long and transition occurs at the beginning of the deceleration phase. The Mayle-criterion predicts the transition too early for such a flow. For the cascade test cases, the correspondence with the experiments is good. There is some underestimation of the skin friction prior to transition due to the neglect of pre-transitional fluctuations in the model. The results obtained so far for cascades are encouraging. In the presentation at the workshop, also heat transfer results will be shown. Tests on transition caused by wake passing in turbine

cascades are done now. Results for these unsteady flow cases will be shown at the workshop. The final goal of the research is to have a model for unsteady transitional flows.
Author
Turbulence Models; Pressure Distribution; K-Omega Turbulence Model; Boundary Layers; Unsteady Flow; Sharp Leading Edges

20040110928 Pratt and Whitney Aircraft, East Hartford, CT, USA
Challenges in Predicting Component Efficiencies in Turbomachines With Low Reynolds Number Blading
Praisner, T. J.; Clark, J. P.; Grover, E. A.; Bertuccioli, L.; Zhang, D.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 476-495; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The ability to predict boundary layer transition locations accurately on turbomachinery airfoils is critical to determine both thermal loads and aerodynamic performance. Here we report on an effort to include an empirically based transition modeling capability in a RANS solver. Testing of well known empirical models from literature against cascade data revealed that the models do not provided enough fidelity for implementation in an airfoil design system. Consequently, a program was launched to develop a new modeling capability that would provide sufficient accuracy for use in the design system. The results of the effort were two empirical models for the prediction of transition onset locations: the first is for attached flow, and the second is for separated flow. To validate the new models, a two-dimensional design optimization of a Low-Pressure Turbine (LPT) airfoil was performed with the objective of increasing airfoil loading by 25%. Subsequent testing of the new airfoil confirmed pre-test predictions of both high and low Reynolds number loss levels. In addition, the accuracy of the new models was benchmarked with a number of legacy cascade and LPT rig data sets. Excellent agreement between measured and predicted profile losses was found in both cascade and rig environments. However, use of the transition modeling capability has elucidated deficiencies in typical RANS simulations that are conducted to predict component performance. Efficiency-versus-span comparisons between data and simulations for multi-stage LPTs indicate that endwall loss levels are significantly under-predicted. Possible causes for the under-predicted endwall losses are discussed as well as suggestions for future improvements that would make RANS-based transitional simulations more robust and accurate.
Author
Turbomachinery; Low Reynolds Number; Aerodynamic Characteristics; Aerodynamic Loads; Boundary Layer Transition; Component Reliability; Performance Prediction

20040110929 NASA Glenn Research Center, Cleveland, OH, USA
Boundary-Layer Separation Control Under Low-Pressure-Turbine Conditions Using Glow-Discharge Plasma Actuators
Hultgren, Lennart; Ashpis, David E.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 349-354; In English; See also 20040110902; No Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Modern low-pressure turbines, in general, utilize highly loaded airfoils in an effort to improve efficiency and to lower the number of airfoils needed. Typically, the airfoil boundary layers are turbulent and fully attached at takeoff conditions, whereas a substantial fraction of the boundary layers on the airfoils may be transitional at cruise conditions due to the change of density with altitude. The strong adverse pressure gradients on the suction side of these airfoils can lead to boundary-layer separation at the latter low Reynolds number conditions. Large separation bubbles, particularly those which fail to reattach, cause a significant degradation of engine efficiency. A component efficiency drop of the order 2% may occur between takeoff and cruise conditions for large commercial transport engines and could be as large as 7% for smaller engines at higher altitude. An efficient means of of separation elimination/reduction is, therefore, crucial to improved turbine design. Because the large change in the Reynolds number from takeoff to cruise leads to a distinct change in the airfoil flow physics, a separation control strategy intended for cruise conditions will need to be carefully constructed so as to incur minimum impact/penalty at takeoff. The focus in the present paper is an experimental study of active separation control using glow discharge plasma actuators. Separation is induced on a flat plate installed in a closed-circuit wind tunnel by a shaped insert on the opposite wall. The flow conditions represent flow over the suction surface of a modern low-pressure-turbine airfoil ('Pak-B'). The Reynolds number, based on wetted plate length and nominal exit velocity, is varied from 50,000 to 300,000, covering cruise to takeoff conditions. Low (0.2%) and high (2.5%) free-stream turbulence intensities are set using passive grids. A spanwise-oriented phased-plasma-array actuator, fabricated on a printed circuit board, is surface-flush-mounted upstream of the separation point and can provide forcing in a wide frequency range. Static surface pressure measurements and hot-wire anemometry of the base and

controlled flows are performed and indicate that the glow-discharge plasma actuator is an effective device for separation control.
Author (revised)
Boundary Layer Separation; Actuators; Active Control; Glow Discharges; Wind Tunnel Tests

20040110938 NASA Langley Research Center, Hampton, VA, USA
A New Approach to Aircraft Robust Performance Analysis
Gregory, Irene M.; Tierno, Jorge E.; January 2004; 8 pp.; In English
Report No.(s): AIAA-96-3860; Copyright; Avail: CASI; A02, Hardcopy
A recently developed algorithm for nonlinear system performance analysis has been applied to an F16 aircraft to begin evaluating the suitability of the method for aerospace problems. The algorithm has a potential to be much more efficient than the current methods in performance analysis for aircraft. This paper is the initial step in evaluating this potential.
Author
Aircraft Performance; Uncertain Systems; Nonlinear Systems; F-16 Aircraft

20040110940 NASA Langley Research Center, Hampton, VA, USA
NASA's Quiet Aircraft Technology Project
Whitfield, Charlotte E.; [2004]; 7 pp.; In English; 24th Congress of the International Council of the Aeronautical Sciences (ICAS 2004), 29 Aug. - 3 Sep. 2004
Contract(s)/Grant(s): 23-781-10-33; No Copyright; Avail: CASI; A02, Hardcopy
NASA's Quiet Aircraft Technology Project is developing physics-based understanding, models and concepts to discover and realize technology that will, when implemented, achieve the goals of a reduction of one-half in perceived community noise (relative to 1997) by 2007 and a further one-half in the far term. Noise sources generated by both the engine and the airframe are considered, and the effects of engine/airframe integration are accounted for through the propulsion airframe aeroacoustics element. Assessments of the contribution of individual source noise reductions to the reduction in community noise are developed to guide the work and the development of new tools for evaluation of unconventional aircraft is underway. Life in the real world is taken into account with the development of more accurate airport noise models and flight guidance methodology, and in addition, technology is being developed that will further reduce interior noise at current weight levels or enable the use of lighter-weight structures at current noise levels.
Author
Aeroacoustics; Aircraft Noise; Noise Reduction; Propulsion

20040110943 NASA Langley Research Center, Hampton, VA, USA
Modeling the Benchmark Active Control Technology Wind-Tunnel Model for Application to Flutter Suppression
Waszak, Martin R.; [1996]; 12 pp.; In English; AIAA Atmospheric Flight Mechanics Conference
Report No.(s): AIAA Paper 96-3437; Copyright; Avail: CASI; A03, Hardcopy
This paper describes the formulation of a model of the dynamic behavior of the Benchmark Active Controls Technology (BACT) wind-tunnel model for application to design and analysis of flutter suppression controllers. The model is formed by combining the equations of motion for the BACT wind-tunnel model with actuator models and a model of wind-tunnel turbulence. The primary focus of this paper is the development of the equations of motion from first principles using Lagrange's equations and the principle of virtual work. A numerical form of the model is generated using values for parameters obtained from both experiment and analysis. A unique aspect of the BACT wind-tunnel model is that it has upper- and lower-surface spoilers for active control. Comparisons with experimental frequency responses and other data show excellent agreement and suggest that simple coefficient-based aerodynamics are sufficient to accurately characterize the aeroelastic response of the BACT wind-tunnel model. The equations of motion developed herein have been used to assist the design and analysis of a number of flutter suppression controllers that have been successfully implemented.
Author
Wind Tunnel Models; Flutter; Vibration Damping; Active Control

20040110944 Computer Sciences Corp., USA
Use of CAD Geometry in MDO
Samareh, Jamshid A.; January 2004; 12 pp.; In English; 6th AIAA/USAF/NASA/ISSMO Symposium on Multidisciplinary Analysis and Optimization, 4-6 Sep. 1996, Bellevue, WA, USA
Report No.(s): AIAA Paper 96-3991; Copyright; Avail: CASI; A03, Hardcopy

The purpose of this paper is to discuss the use of Computer-Aided Design (CAD) geometry in a Multi-Disciplinary Design Optimization (MDO) environment. Two techniques are presented to facilitate the use of CAD geometry by different disciplines, such as Computational Fluid Dynamics (CFD) and Computational Structural Mechanics (CSM). One method is to transfer the load from a CFD grid to a CSM grid. The second method is to update the CAD geometry for CSM deflection.
Author
Aircraft Design; Computer Aided Design; Multidisciplinary Design Optimization

20040110949 NASA Langley Research Center, Hampton, VA, USA, George Washington Univ., Hampton, VA, USA, Department of the Air Force, USA
A Sizing Methodology for the Conceptual Design of Blended-Wing-Body Transports
Kimmel, William M., Technical Monitor; Bradley, Kevin R.; September 2004; 39 pp.; In English
Contract(s)/Grant(s): NCC1-03006; WU 23-319-30-02
Report No.(s): NASA/CR-2004-213016; No Copyright; Avail: CASI; A03, Hardcopy
This paper describes the development of a methodology for sizing Blended-Wing-Body (BWB) transports and how the capabilities of the Flight Optimization System (FLOPS) have been expanded using that methodology. In this approach, BWB transports are sized based on the number of passengers in each class that must fit inside the centerbody or pressurized vessel. Weight estimation equations for this centerbody structure were developed using Finite Element Analysis (FEA). This paper shows how the sizing methodology has been incorporated into FLOPS to enable the design and analysis of BWB transports. Previous versions of FLOPS did not have the ability to accurately represent or analyze BWB configurations in any reliable, logical way. The expanded capabilities allow the design and analysis of a 200 to 450-passenger BWB transport or the analysis of a BWB transport for which the geometry is already known. The modifications to FLOPS resulted in differences of less than 4 percent for the ramp weight of a BWB transport in this range when compared to previous studies performed by NASA and Boeing.
Author
Design Analysis; Aircraft Design; Flight Optimization

20040110952 NASA Langley Research Center, Hampton, VA, USA
Transonic Free-To-Roll Analysis of the F/A-18E and F-35 Configurations
Owens, D. Bruce; McConnell, Jeffrey K.; Brandon, Jay M.; Hall, Robert M.; [2004]; 19 pp.; In English; AIAA Atmospheric Flight Mechanics Conference, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 23-762-45-DB
Report No.(s): AIAA Paper 2004-5053; Copyright; Avail: CASI; A03, Hardcopy
The free-to-roll technique is used as a tool for predicting areas of uncommanded lateral motions. Recently, the NASA/Navy/Air Force Abrupt Wing Stall Program extended the use of this technique to the transonic speed regime. Using this technique, this paper evaluates various wing configurations on the pre-production F/A-18E aircraft and the Joint Strike Fighter (F-35) aircraft. The configurations investigated include leading and trailing edge flap deflections, fences, leading edge flap gap seals, and vortex generators. These tests were conducted in the NASA Langley 16-Foot Transonic Tunnel. The analysis used a modification of a figure-of-merit developed during the Abrupt Wing Stall Program to discern configuration effects. The results showed how the figure-of-merit can be used to schedule wing flap deflections to avoid areas of uncommanded lateral motion. The analysis also used both static and dynamic wind tunnel data to provide insight into the uncommanded lateral behavior. The dynamic data was extracted from the time history data using parameter identification techniques. In general, modifications to the pre-production F/A-18E resulted in shifts in angle-of-attack where uncommanded lateral activity occurred. Sealing the gap between the inboard and outboard leading-edge flaps on the Navy version of the F-35 eliminated uncommanded lateral activity or delayed the activity to a higher angle-of-attack.
Author
Transonic Speed; Wing Flaps; Trailing Edge Flaps; Roll; Leading Edge Flaps; Aerodynamic Configurations

20040110955 NASA Langley Research Center, Hampton, VA, USA
Analysis of Wind Tunnel Lateral Oscillatory Data of the F-16XL Aircraft
Klein, Vladislav; Murphy, Patrick C.; Szyba, Nathan M.; August 2004; 114 pp.; In English
Contract(s)/Grant(s): 23-762-45-DB
Report No.(s): NASA/TM-2004-213246; L-18387; No Copyright; Avail: CASI; A06, Hardcopy
Static and dynamic wind tunnel tests were performed on an 18% scale model of the F-16XL aircraft. These tests were

performed over a wide range of angles of attack and sideslip with oscillation amplitudes from 5 deg. to 30 deg. and reduced frequencies from 0.073 to 0.269. Harmonic analysis was used to estimate Fourier coefficients and in-phase and out-of-phase components. For frequency dependent data from rolling oscillations, a two-step regression method was used to obtain unsteady models (indicial functions), and derivatives due to sideslip angle, roll rate and yaw rate from in-phase and out-of-phase components. Frequency dependence was found for angles of attack between 20 deg. and 50 deg. Reduced values of coefficient of determination and increased values of fit error were found for angles of attack between 35 deg. and 45 deg. An attempt to estimate model parameters from yaw oscillations failed, probably due to the low number of test cases at different frequencies. Author

Wind Tunnel Tests; Harmonic Analysis; Oscillations; Dynamic Tests; Scale Models

20040110965 NASA Langley Research Center, Hampton, VA, USA

NASA's Dual-Fuel Airbreathing Hypersonic Vehicle Study

Hunt, James L.; Eiswirth, Edward A.; [1996]; 6 pp.; In English

Report No.(s): AIAA Paper 96-4591; Copyright; Avail: CASI; A02, Hardcopy

A Mach 10 cruise vehicle provides a quick response, global reach capability with high survivability. For operations from CONUS, mission radii on the order of 8,000 nmi are sufficient. For missions which return to CONUS, a dual-fueled vehicle is superior, due to its capability to in-flight refuel. However, for one-way mission, an all-hydrogen vehicle is preferable because of its higher specific impulse.

Author

Air Breathing Engines; Hypersonic Vehicles; NASA Programs; Hydrogen Fuels

20040110967 NASA Langley Research Center, Hampton, VA, USA

Structural Concepts Study of Non-circular Fuselage Configurations

Mukhopadhyay, Vivel; [1996]; 14 pp.; In English; SAE/AIAA World Aviation Congress, 22-24 Oct. 1996, Los Angeles, CA, USA

Report No.(s): AIAA Paper 96-WAC-67; Copyright; Avail: CASI; A03, Hardcopy

A preliminary study of structural concepts for noncircular fuselage configurations is presented. For an unconventional flying-wing type aircraft, in which the fuselage is inside the wing, multiple fuselage bays with non-circular sections need to be considered. In a conventional circular fuselage section, internal pressure is carried efficiently by a thin skin via hoop tension. If the section is non-circular, internal pressure loads also induce large bending stresses. The structure must also withstand additional bending and compression loads from aerodynamic and gravitational forces. Flat and vaulted shell structural configurations for such an unconventional, non-circular pressurized fuselage of a large flying-wing were studied. A deep honeycomb sandwich-shell and a ribbed double-wall shell construction were considered. Combinations of these structural concepts were analyzed using both analytical and simple finite element models of isolated sections for a comparative conceptual study. Weight, stress, and deflection results were compared to identify a suitable configuration for detailed analyses. The flat sandwich-shell concept was found preferable to the vaulted shell concept due to its superior buckling stiffness. Vaulted double-skin ribbed shell configurations were found to be superior due to their weight savings, load diffusion, and fail-safe features. The vaulted double-skin ribbed shell structure concept was also analyzed for an integrated wing-fuselage finite element model. Additional problem areas such as wing-fuselage junction and pressure-bearing spar were identified.

Author

Tailless Aircraft; Aircraft Structures; Fuselages; Structural Analysis

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*.

20040095905 NASA Langley Research Center, Hampton, VA, USA

Switching LPV Control for High Performance Tactical Aircraft

Lu, Bei; Wu, Fen; Kim, SungWan; [2004]; 11 pp.; In English; AIAA Guidance, Navigation and Control Conference, 16-19 Aug. 2004, Providence, RI, USA

Contract(s)/Grant(s): NAG1-01119; 23-762-65-AG

Report No.(s): AIAA Paper 2004-4999; Copyright; Avail: CASI; A03, Hardcopy

This paper examines a switching Linear Parameter-Varying (LPV) control approach to determine if it is practical to use for flight control designs within a wide angle of attack region. The approach is based on multiple parameter-dependent Lyapunov functions. The full parameter space is partitioned into overlapping subspaces and a family of LPV controllers are designed, each suitable for a specific parameter subspace. The hysteresis switching logic is used to accomplish the transition among different parameter subspaces. The proposed switching LPV control scheme is applied to an F-16 aircraft model with different actuator dynamics in low and high angle of attack regions. The nonlinear simulation results show that the aircraft performs well when switching among different angle of attack regions.
Author
Actuators; Controllers; Flight Control; Linear Parameter-Varying Control; Switching

20040095917 NASA Langley Research Center, Hampton, VA, USA
A New Approach to Attitude Stability and Control for Low Airspeed Vehicles
Lim, K. B.; Shin, Y-Y.; Moerder, D. D.; Cooper, E. G.; [2004]; 16 pp.; In English; AIAA Guidance, Navigation and Control Conference and Exhibit, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 090-20-15
Report No.(s): AIAA Paper 2004-5008; No Copyright; Avail: CASI; A03, Hardcopy

This paper describes an approach for controlling the attitude of statically unstable thrust-levitated vehicles in hover or slow translation. The large thrust vector that characterizes such vehicles can be modulated to provide control forces and moments to the airframe, but such modulation is accompanied by significant unsteady flow effects. These effects are difficult to model, and can compromise the practical value of thrust vectoring in closed-loop attitude stability, even if the thrust vectoring machinery has sufficient bandwidth for stabilization. The stabilization approach described in this paper is based on using internal angular momentum transfer devices for stability, augmented by thrust vectoring for trim and other 'outer loop' control functions. The three main components of this approach are: (1) a z-body axis angular momentum bias enhances static attitude stability, reducing the amount of control activity needed for stabilization, (2) optionally, gimbaled reaction wheels provide high-bandwidth control torques for additional stabilization, or agility, and (3) the resulting strongly coupled system dynamics are controlled by a multivariable controller. A flight test vehicle is described, and nonlinear simulation results are provided that demonstrate the efficiency of the approach.
Author
Thrust Vector Control; Approach Control; Static Stability

20040110240 NASA Langley Research Center, Hampton, VA, USA
A Disturbance Rejection Approach to Actuator and Sensor Placement
Lim, K. B.; [1997]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

For various reasons as discussed for instance in, the selection of actuator and sensor positions is still ad hoc. This is especially true for flexible structures where many candidate configurations can exist. This study is an attempt to make the selection process more methodical. One approach to actuator and sensor placement is to optimize a closed loop performance metric directly by selecting the actuators, sensors, and controller gains simultaneously. This direct approach makes sense if the desired closed loop performance is well defined. Since the individual actuator and sensor contributions to the closed loop performance metric is complex, the solution strategy usually employs non linear programming with many design and numerical iterations. A second approach is to select actuators and/or sensors based on open loop properties so that closed loop performance is indirectly optimized. Since the individual sensor and actuator contributions to the open loop metric is simple, nonlinear optimization is usually not needed. This approach will suggest efficient actuator and sensor configurations for any type of control law. The method suggested in this study falls into the latter class of approaches.
Author
Actuators; Feedback Control; Linear Programming

20040110330 NASA Langley Research Center, Hampton, VA, USA
Pilot In Command: A Feasibility Assessment of Autonomous Flight Management Operations
Wing, David J.; Ballin, Mark G.; Krishnamurthy, Karthik; [2004]; 15 pp.; In English; 24th International Congress of the Aeronautical Sciences (ICAS 2004), 30 Aug. - 3 Sep. 2004, Yokohama, Japan
Contract(s)/Grant(s): 727-01-10; Copyright; Avail: CASI; A03, Hardcopy

Several years of NASA research have produced the air traffic management operational concept of Autonomous Flight Management with high potential for operational feasibility, significant system and user benefits, and safety. Among the chief

potential benefits are demand-adaptive or scalable capacity, user flexibility and autonomy that may finally enable truly successful business strategies, and compatibility with current-day operations such that the implementation rate can be driven from within the user community. A concept summary of Autonomous Flight Management is provided, including a description of how these operations would integrate in shared airspace with existing ground-controlled flight operations. The mechanisms enabling the primary benefits are discussed, and key findings of a feasibility assessment of airborne autonomous operations are summarized. Concept characteristics that impact safety are presented, and the potential for initially implementing Autonomous Flight Management is discussed.
Author
Flight Management Systems; Feasibility Analysis; Autonomy

20040110660 NASA Langley Research Center, Hampton, VA, USA
Pilot Performance With Predictive System Status Information
Trujillo, Anna C.; [1997]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Research has shown a strong pilot preference for predictive information of aircraft system status in the flight deck. However, the benefits of predictive information have not been quantitatively demonstrated. The study described here attempted to identify and quantify these benefits if they existed. In this simulator experiment, three types of predictive information (none, whether a parameter was changing abnormally, and the time for a parameter to reach an alert range) and four initial times to an alert (1 minute, 5 minutes, 15 minutes, and ETA+ 45 minutes) were found to affect when subjects accomplished certain actions, such as accessing pertinent checklists, declaring emergencies, diverting, and calling the flight attendant and dispatch.
Author
Information Systems; Avionics; Predictions; System Failures; Pilot Performance

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*.

20040095921 NASA Langley Research Center, Hampton, VA, USA
Anticipated Effectiveness of Active Noise Control in Propeller Aircraft Interiors as Determined by Sound Quality Tests
Powell, Clemans A.; Sullivan, Brenda M.; [2004]; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Two experiments were conducted, using sound quality engineering practices, to determine the subjective effectiveness of hypothetical active noise control systems in a range of propeller aircraft. The two tests differed by the type of judgments made by the subjects: pair comparisons in the first test and numerical category scaling in the second. Although the results of the two tests were in general agreement that the hypothetical active control measures improved the interior noise environments, the pair comparison method appears to be more sensitive to subtle changes in the characteristics of the sounds which are related to passenger preference.
Author
Aircraft Compartments; Noise Reduction; Aircraft Noise; Active Control; Propeller Noise; Aeroacoustics

20040105516 NASA Langley Research Center, Hampton, VA, USA
Experimental Study of a Nozzle Using Fluidic Counterflow for Thrust Vectoring
Flamm, Jeffrey D.; [1998]; 28 pp.; In English; 34th AIAA/ASME SAE/ASEE Joint Propulsion Conference and Exhibit, 13-15 Jul. 1998, Cleveland, OH, USA
Report No.(s): AIAA Paper 98-3255; Copyright; Avail: CASI; A03, Hardcopy

A static experimental investigation of a counterflow thrust vectoring nozzle concept was performed. The study was conducted in the NASA Langley Research Center Jet Exit Test Facility. Internal performance characteristics were defined over a nozzle pressure ratio (jet total to ambient) range of 3.5 to 10.0. The effects of suction collar geometry and suction slot height on nozzle performance were examined. In the counterflow concept, thrust vectoring is achieved by applying a vacuum to a slot adjacent to a primary jet that is shrouded by a suction collar. Two flow phenomena work to vector the primary jet depending upon the test conditions and configuration. In one case, the vacuum source creates a secondary reverse flowing stream near the primary jet. The shear layers between the two counterflowing streams mix and entrain mass from the

surrounding fluid. The presence of the collar inhibits mass entrainment and the flow near the collar accelerates, causing a drop in pressure on the collar. The second case works similarly except that the vacuum is not powerful enough to create a counterflowing stream and instead a coflowing stream is present. The primary jet is vectored if suction is applied asymmetrically on the top or bottom of the jet.
Author
Counterflow; Fluidics; Thrust Vector Control; Convergent-Divergent Nozzles; Nozzle Thrust Coefficients

20040105539 NASA Langley Research Center, Hampton, VA, USA
Transpiring Cooling of a Scram-Jet Engine Combustion Chamber
Choi, Sang H.; Scotti, Stephen J.; Song, Kyo D.; Ries,Heidi; [1997]; 8 pp.; In English
Contract(s)/Grant(s): NAG1-1513
Report No.(s): AIAA Paper 97-2576; Copyright; Avail: CASI; A02, Hardcopy

The peak cold-wall heating rate generated in a combustion chamber of a scram-jet engine can exceed 2000 Btu/sq ft sec (approx. 2344 W/sq cm). Therefore, a very effective heat dissipation mechanism is required to sustain such a high heating load. This research focused on the transpiration cooling mechanism that appears to be a promising approach to remove a large amount of heat from the engine wall. The transpiration cooling mechanism has two aspects. First, initial computations suggest that there is a reduction, as much as 75%, in the heat flux incident on the combustion chamber wall due to the transpirant modifying the combustor boundary layer. Secondly, the heat reaching the combustor wall is removed from the structure in a very effective manner by the transpirant. It is the second of these two mechanisms that is investigated experimentally in the subject paper. A transpiration cooling experiment using a radiant heating method, that provided a heat flux as high as 200 Btu/sq ft sec (approx. 234 W/sq cm) on the surface of a specimen, was performed. The experiment utilized an arc-lamp facility (60-kW radiant power output) to provide a uniform heat flux to a test specimen. For safety reasons, helium gas was used as the transpirant in the experiments. The specimens were 1.9-cm diameter sintered, powdered-stainless-steel tubes of various porosities and a 2.54cm square tube with perforated multi-layered walls. A 15-cm portion of each specimen was heated. The cooling effectivenes and efficiencies by transpiration for each specimen were obtained using the experimental results. During the testing, various test specimens displayed a choking phenomenon in which the transpirant flow was limited as the heat flux was increased. The paper includes a preliminary analysis of the transpiration cooling mechanism and a scaling conversion study that translates the results from helium tests into the case when a hydrogen medium is used.
Author
Transpiration; Sweat Cooling; Supersonic Combustion Ramjet Engines

20040105540 NASA Langley Research Center, Hampton, VA, USA
Multidisciplinary Approach to Linear Aerospike Nozzle Optimization
Korte, J. J.; Salas, A. O.; Dunn, H. J.; Alexandrov, N. M.; Follett, W. W.; Orient, G. E.; Hadid, A. H.; [1997]; 8 pp.; In English
Report No.(s): AIAA Paper 97-3374; Copyright; Avail: CASI; A02, Hardcopy

A model of a linear aerospike rocket nozzle that consists of coupled aerodynamic and structural analyses has been developed. A nonlinear computational fluid dynamics code is used to calculate the aerodynamic thrust, and a three-dimensional fink-element model is used to determine the structural response and weight. The model will be used to demonstrate multidisciplinary design optimization (MDO) capabilities for relevant engine concepts, assess performance of various MDO approaches, and provide a guide for future application development. In this study, the MDO problem is formulated using the multidisciplinary feasible (MDF) strategy. The results for the MDF formulation are presented with comparisons against sequential aerodynamic and structural optimized designs. Significant improvements are demonstrated by using a multidisciplinary approach in comparison with the single- discipline design strategy.
Author
Aerospike Engines; Engine Design; Multidisciplinary Design Optimization; Rocket Nozzles; Structural Analysis; Three Dimensional Models

20040110325 NASA Langley Research Center, Hampton, VA, USA
Ducted-Fan Engine Acoustic Predictions using a Navier-Stokes Code
Rumsey, C. L.; Biedron, R. T.; Farassat, F.; Spence, P. L.; Journal of Sound and Vibration; June 1998; Volume 123, No. 4, pp. 643-664; In English; Copyright; Avail: CASI; A03, Hardcopy

A Navier-Stokes computer code is used to predict one of the ducted-fan engine acoustic modes that results from rotor-wake/stator-blade interaction. A patched sliding-zone interface is employed to pass information between the moving

rotor row and the stationary stator row. The code produces averaged aerodynamic results downstream of the rotor that agree well with a widely used average-passage code. The acoustic mode of interest is generated successfully by the code and is propagated well upstream of the rotor; temporal and spatial numerical resolution are fine enough such that attenuation of the signal is small. Two acoustic codes are used to find the far-field noise. Near-field propagation is computed by using Eversman's wave envelope code, which is based on a finite-element model. Propagation to the far field is accomplished by using the Kirchhoff formula for moving surfaces with the results of the wave envelope code as input data. Comparison of measured and computed far-field noise levels show fair agreement in the range of directivity angles where the peak radiation lobes from the inlet are observed. Although only a single acoustic mode is targeted in this study, the main conclusion is a proof-of-concept: Navier-Stokes codes can be used both to generate and propagate rotor/stator acoustic modes forward through an engine, where the results can be coupled to other far-field noise prediction codes.
Author
Aeroacoustics; Engine Noise; Ducted Fan Engines; Jet Aircraft Noise; Noise Prediction

20040110377 NASA Langley Research Center, Hampton, VA, USA
Enhancement of Mixing and Reaction in High-speed Combustor Flowfields
Drummond, J. Philip; [1997]; 15 pp.; In English; International Colloquium on Advanced Computation and Analysis of Combustion, 12-15 May 1997, Moscow, Russia; No Copyright; Avail: CASI; A03, Hardcopy

Research has been underway for a number of years, both in the USA and abroad, to develop advanced aerospace propulsion systems for use late in this century and beyond. One program is now underway at the NASA Langley Research Research has been underway for a number of years, both in the USA and abroad, to develop advanced aerospace propulsion systems for use late in this century and beyond. One program is now underway at the NASA Langley Research Center to develop a hydrogen-fueled supersonic combustion ramjet (scramjet) that is capable of propelling a vehicle at hypersonic speeds in the atmosphere. A part of that research has been directed toward the optimization of the scramjet combustor and, in particular, the efficiency of fuel-air mixing and reaction taking place in the engine. In the high-speed vehicle configurations currently being considered, achieving a high combustor efficiency becomes particularly difficult. With increasing combustor Mach number, the degree of fuel-air mixing that can be achieved through natural convective and diffusive processes is reduced leading to an overall decrease in combustion efficiency and thrust. Compressible shear layers and jets provide a good model for studying the physical processes occurring in high speed mixing and combustion in a scramjet. Mixing layers are characterized by large scale eddies that form due to the high shear that is present between the fuel and the air streams. These eddies entrain the fuel and air into the mixing region between the fluids leading to increased surface area and locally steep concentration gradients. Molecular diffusion then occurs across the strained interfaces. In an early study of high-speed mixing, Brown and Roshko show that the spreading rate of a supersonic mixing layer decreases with increasing Mach number, exhibiting a factor of three decrease in spread rate as compared with an incompressible mixing layer with the same density ratio. They conclude that the reduced spread rate is primarily due to compressibility. Papamoschou and Roshko also observe that the spreading rate of compressible mixing layers is significantly reduced over that of incompressible layers. To characterize the structure of the flow quantitatively, they define a convective Mach number. The reduction in mixing layer spreading rate is shown in these experiments to correlate well with increasing convective Mach number.
Derived from text
Air Flow; Combustion Chambers; Combustion Efficiency; Propulsion System Performance; Propulsion System Configurations

20040110738 NASA Langley Research Center, Hampton, VA, USA
Helicopter Rotor Noise Prediction: Background, Current Status, and Future Direction
Brentner, Kenneth S.; [1997]; 50 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Helicopter noise prediction is increasingly important. The purpose of this viewgraph presentation is to: 1) Put into perspective the recent progress; 2) Outline current prediction capabilities; 3) Forecast direction of future prediction research; 4) Identify rotorcraft noise prediction needs. The presentation includes an historical perspective, a description of governing equations, and the current status of source noise prediction.
Derived from text
Helicopters; Aircraft Noise; Noise Prediction; Aeroacoustics

20040110826 NASA Glenn Research Center, Cleveland, OH, USA
An Overview of Magnetic Bearing Technology for Gas Turbine Engines
Clark, Daniel J.; Jansen, Mark J.; Montague, Gerald T.; August 2004; 14 pp.; In English
Contract(s)/Grant(s): WBS 22-708-01-03; DA Proj. 1L1-62211-A-47-A
Report No.(s): NASA/TM-2004-213177; ARL-TR-3254; E-14672; No Copyright; Avail: CASI; A03, Hardcopy

The idea of the magnetic bearing and its use in exotic applications has been conceptualized for many years, over a century, in fact. Patented, passive systems using permanent magnets date back over 150 years. More recently, scientists of the 1930s began investigating active systems using electromagnets for high-speed ultracentrifuges. However, passive magnetic bearings are physically unstable and active systems only provide proper stiffness and damping through sophisticated controllers and algorithms. This is precisely why, until the last decade, magnetic bearings did not become a practical alternative to rolling element bearings. Today, magnetic bearing technology has become viable because of advances in micro-processing controllers that allow for confident and robust active control. Further advances in the following areas: rotor and stator materials and designs which maximize flux, minimize energy losses, and minimize stress limitations; wire materials and coatings for high temperature operation; high-speed micro processing for advanced controller designs and extremely robust capabilities; back-up bearing technology for providing a viable touchdown surface; and precision sensor technology; have put magnetic bearings on the forefront of advanced, lubrication free support systems. This paper will discuss a specific joint program for the advancement of gas turbine engines and how it implies the vitality of magnetic bearings, a brief comparison between magnetic bearings and other bearing technologies in both their advantages and limitations, and an examination of foreseeable solutions to historically perceived limitations to magnetic bearing.
Author
Turbomachinery; Magnetic Bearings; Active Control; Lubrication Systems; High Temperature; Gas Turbine Engines

20040110827 NASA Glenn Research Center, Cleveland, OH, USA
Thermal Load Considerations for Detonative Combustion-Based Gas Turbine Engines
Paxson, Daniel E.; Perkins, H. Douglas; August 2004; 19 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): WBS 22-708-90-05
Report No.(s): NASA/TM-2004-213190; AIAA Paper 2004-3396; E-14689; No Copyright; Avail: CASI; A03, Hardcopy

An analysis was conducted to assess methods for, and performance implications of, cooling the passages (tubes) of a pulse detonation-based combustor conceptually installed in the core of a gas turbine engine typical of regional aircraft. Temperature-limited material stress criteria were developed from common-sense engineering practice, and available material properties. Validated, one-dimensional, numerical simulations were then used to explore a variety of cooling methods and establish whether or not they met the established criteria. Simulation output data from successful schemes were averaged and used in a cycle-deck engine simulation in order to assess the impact of the cooling method on overall performance. Results were compared to both a baseline engine equipped with a constant-pressure combustor and to one equipped with an idealized detonative combustor. Major findings indicate that thermal loads in these devices are large, but potentially manageable. However, the impact on performance can be substantial. Nearly one half of the ideally possible specific fuel consumption (SFC) reduction is lost due to cooling of the tubes. Details of the analysis are described, limitations are presented, and implications are discussed.
Author
Detonation; Gas Turbine Engines; Fuel Consumption; Combustion Chambers

20040110831 NASA Glenn Research Center, Cleveland, OH, USA
A Foreign Object Damage Event Detector Data Fusion System for Turbofan Engines
Turso, James A.; Litt, Jonathan S.; August 2004; 27 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): WBS 22-303-30-72; DA Proj. 1L1-61102-AF-20
Report No.(s): NASA/TM-2004-213192; ARL-TR-3201; AIAA Paper 2004-4047; E-14691; No Copyright; Avail: CASI; A03, Hardcopy

A Data Fusion System designed to provide a reliable assessment of the occurrence of Foreign Object Damage (FOD) in a turbofan engine is presented. The FOD-event feature level fusion scheme combines knowledge of shifts in engine gas path performance obtained using a Kalman filter, with bearing accelerometer signal features extracted via wavelet analysis, to positively identify a FOD event. A fuzzy inference system provides basic probability assignments (bpa) based on features extracted from the gas path analysis and bearing accelerometers to a fusion algorithm based on the Dempster-Shafer-Yager Theory of Evidence. Details are provided on the wavelet transforms used to extract the foreign object strike features from the noisy data and on the Kalman filter-based gas path analysis. The system is demonstrated using a turbofan engine combined-effects model (CEM), providing both gas path and rotor dynamic structural response, and is suitable for rapid-prototyping of control and diagnostic systems. The fusion of the disparate data can provide significantly more reliable detection of a FOD event than the use of either method alone. The use of fuzzy inference techniques combined with

Dempster-Shafer-Yager Theory of Evidence provides a theoretical justification for drawing conclusions based on imprecise or incomplete data.
Author
Turbofan Engines; Detectors; Multisensor Fusion; Foreign Bodies; Impact Damage

20040110832 NASA Glenn Research Center, Cleveland, OH, USA
Sensor Needs for Control and Health Management of Intelligent Aircraft Engines
Simon, Donald L.; Gang, Sanjay; Hunter, Gary W.; Guo, Ten-Huei; Semega, Kenneth J.; August 2004; 17 pp.; In English; Turbo Expo 2004, 14-17 Jun. 2004, Vienna, Austria
Contract(s)/Grant(s): WBS 22-728-30-05; DA Proj. 1L1-161102-AF-20
Report No.(s): NASA/TM-2004-213202; ARL-TR-3251; GT2004-54324; E-14711; No Copyright; Avail: CASI; A03, Hardcopy

NASA and the U.S. Department of Defense are conducting programs which support the future vision of 'intelligent' aircraft engines for enhancing the affordability, performance, operability, safety, and reliability of aircraft propulsion systems. Intelligent engines will have advanced control and health management capabilities enabling these engines to be self-diagnostic, self-prognostic, and adaptive to optimize performance based upon the current condition of the engine or the current mission of the vehicle. Sensors are a critical technology necessary to enable the intelligent engine vision as they are relied upon to accurately collect the data required for engine control and health management. This paper reviews the anticipated sensor requirements to support the future vision of intelligent engines from a control and health management perspective. Propulsion control and health management technologies are discussed in the broad areas of active component controls, propulsion health management and distributed controls. In each of these three areas individual technologies will be described, input parameters necessary for control feedback or health management will be discussed, and sensor performance specifications for measuring these parameters will be summarized.
Author
Aircraft Engines; Active Control; Aircraft Control; Engine Control

20040110853 NASA Glenn Research Center, Cleveland, OH, USA
Experimental Investigation of a Multiplex Fuel Injector Module With Discrete Jet Swirlers for Low Emission Combustors
Tacina, Robert; Mao, Chien-Pei; Wey, Changlie; August 2004; 20 pp.; In English; 42nd Aerospace Sciences Meeting and Exhibit, 5-8 Jan. 2004, Reno, NV, USA
Contract(s)/Grant(s): WBS 22-719-30-03
Report No.(s): NASA/TM-2004-212918; AIAA Paper 2004-0185; E-14358; No Copyright; Avail: CASI; A03, Hardcopy

A low-NOx emissions combustor concept has been demonstrated in flame-tube tests. A lean-direct injection (LDI) concept was used where the fuel is injected directly into the flame zone and the overall equivalence ratio of the mixture is lean. The LDI concept described in this report is a multiplex fuel injector module containing multipoint fuel injection tips and multi-burning zones. The injector module comprises 25 equally spaced injection tips within a 76 by 76 mm area that fits into the flame-tube duct. The air swirlers were made from a concave plate on the axis of the fuel injector using drilled holes at an angle to the axis of the fuel injector. The NOx levels were quite low and are greater than 70 percent lower than the 1996 ICAO standard. At an inlet temperature of 810 K, inlet pressure of 2760 kPa, pressure drop of 4 percent and a flame temperature of 1900 K with JP8 fuel, the NOx emission index was 9. The 25-point injector module exhibited the most uniform radial distribution of fuel-air mixture and NOx emissions in the flame tube when compared to other multipoint injection devices. A correlation is developed relating the NOx emissions to inlet temperature, inlet pressure, equivalence ratio and pressure drop.
Author
Combustion Chambers; Fuel Injection; Contaminants; Exhaust Emission; Turbine Engines; Swirling

20040110855 NASA Glenn Research Center, Cleveland, OH, USA
A Study on the Requirements for Fast Active Turbine Tip Clearance Control Systems
DeCastro, Jonathan A.; Melcher, Kevin J.; July 2004; 24 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): WBS 22-714-70-08
Report No.(s): NASA/TM-2004-213121; E-14615; AIAA Paper 2004-4176; No Copyright; Avail: CASI; A03, Hardcopy

This paper addresses the requirements of a control system for active turbine tip clearance control in a generic commercial

turbofan engine through design and analysis. The control objective is to articulate the shroud in the high pressure turbine section in order to maintain a certain clearance set point given several possible engine transient events. The system must also exhibit reasonable robustness to modeling uncertainties and reasonable noise rejection properties. Two actuators were chosen to fulfill such a requirement, both of which possess different levels of technological readiness: electrohydraulic servovalves and piezoelectric stacks. Identification of design constraints, desired actuator parameters, and actuator limitations are addressed in depth; all of which are intimately tied with the hardware and controller design process. Analytical demonstrations of the performance and robustness characteristics of the two axisymmetric LQG clearance control systems are presented. Takeoff simulation results show that both actuators are capable of maintaining the clearance within acceptable bounds and demonstrate robustness to parameter uncertainty. The present model-based control strategy was employed to demonstrate the tradeoff between performance, control effort, and robustness and to implement optimal state estimation in a noisy engine environment with intent to eliminate ad hoc methods for designing reliable control systems.
Author
Turbines; Clearances; Turbofan Engines; Active Control; Design Analysis

20040110927 Technische Univ., Hanover, Germany
Observations on the Causal Relationship Between Blade Count and Developing Rotating Stall in a Four Stage Axial Compressor
Hellmich, Bernd; Braun, Michael; Fischer, Axel; Seume, Joerg R.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 496-519; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The frequency spectra of signals from pressure transducers mounted in axial and circumferential locations in the casing wall of a compressor, as well as a dynamic flow probe were analysed throughout stable operation, incipient and fully developed rotating stall. From the properties of the Auto Power Spectral Densities (APSD) and the relative phase and coherence of two signals, the stall frequency and its higher harmonics were estimated. The conclusions are: The stochastic estimators APSD and coherence are useful for precursor identification and for detection, if the compressor approaches the stability limit slowly (e.g. during cruise operation or base load in power plants). An acoustic resonance in the rotor tip region precedes rotating stall when increasing aerodynamic loading. The precursor and rotating stall frequencies are related to blading passage blockage. They can be estimated from integer fractions of the rotor/stator - the ratio of the stall frequency and the frequency of rotation is a function of the common divisors of the blade numbers in the rotor and stator blade count.
Author
Aerodynamic Loads; Turbocompressors; Stator Blades; Harmonics; Rotating Stalls

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*.

20040105588 NASA Langley Research Center, Hampton, VA, USA
Stability Analysis for Constrained Principal Axis Slew Maneuvers
Seywald, Hans; Lim, Kyong B.; Anthony, Tobin C.; [1996]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

This paper addresses the problem of reorienting a rigid spacecraft from arbitrary initial conditions to prescribed final conditions with zero angular velocity. The control law analyzed is based on quaternion feedback and leaves the user to choose two gains as functions of position, angular rate, and time. For arbitrary initial states, conditions on the controller gains are identified that guarantee global asymptotic stability. For the special case of rest-to-rest reorientations, the control law reduces to earlier results involving a principal axis rotation. The paper also addresses slew rate constraints, both, in terms of the two and infinity norms.
Author
Rigid Structures; Maneuverable Spacecraft; Rotating Bodies; Satellite Orientation; Spacecraft Stability

20040105598 NASA Langley Research Center, Hampton, VA, USA
Extension of a Kolmogorov Atmospheric Turbulence Model for Time-Based Simulation Implementation
McMinn, John D.; [1997]; 13 pp.; In English
Report No.(s): AIAA Paper 97-3532; Copyright; Avail: CASI; A03, Hardcopy

The development of any super/hypersonic aircraft requires the interaction of a wide variety of technical disciplines to maximize vehicle performance. For flight and engine control system design and development on this class of vehicle, realistic mathematical simulation models of atmospheric turbulence, including winds and the varying thermodynamic properties of the atmosphere, are needed. A model which has been tentatively selected by a government/industry group of flight and engine/inlet controls representatives working on the High Speed Civil Transport is one based on the Kolmogorov spectrum function. This report compares the Dryden and Kolmogorov turbulence forms, and describes enhancements that add functionality to the selected Kolmogorov model. These added features are: an altitude variation of the eddy dissipation rate based on Dryden data, the mapping of the eddy dissipation rate database onto a regular latitude and longitude grid, a method to account for flight at large vehicle attitude angles, and a procedure for transitioning smoothly across turbulence segments.
Author
Mathematical Models; Engine Control; Supersonic Transports; Thermodynamic Properties; Turbulence Models; Control Systems Design

20040105654 NASA Dryden Flight Research Center, Edwards, CA, USA
Selected Flight Test Results for Online Learning Neural Network-Based Flight Control System
Williams, Peggy S.; [2004]; 10 pp.; In English; AIAA Intelligent Systems Conference, 20-22 Sep. 2004, Chicago, IL, USA; No Copyright; Avail: CASI; A02, Hardcopy

The NASA F-15 Intelligent Flight Control System project team has developed a series of flight control concepts designed to demonstrate the benefits of a neural network-based adaptive controller. The objective of the team is to develop and flight-test control systems that use neural network technology to optimize the performance of the aircraft under nominal conditions as well as stabilize the aircraft under failure conditions. Failure conditions include locked or failed control surfaces as well as unforeseen damage that might occur to the aircraft in flight. This report presents flight-test results for an adaptive controller using stability and control derivative values from an online learning neural network. A dynamic cell structure neural network is used in conjunction with a real-time parameter identification algorithm to estimate aerodynamic stability and control derivative increments to the baseline aerodynamic derivatives in flight. This set of open-loop flight tests was performed in preparation for a future phase of flights in which the learning neural network and parameter identification algorithm output would provide the flight controller with aerodynamic stability and control derivative updates in near real time. Two flight maneuvers are analyzed a pitch frequency sweep and an automated flight-test maneuver designed to optimally excite the parameter identification algorithm in all axes. Frequency responses generated from flight data are compared to those obtained from nonlinear simulation runs. An examination of flight data shows that addition of the flight-identified aerodynamic derivative increments into the simulation improved the pitch handling qualities of the aircraft.
Author
Flight Tests; Neural Nets; Flight Control; Adaptive Control; Parameter Identification; Control Theory

20040110231 NASA Langley Research Center, Hampton, VA, USA
Robust Control of Non-Passive Systems via Passification
Kelkar, A. G.; Joshi, S. M.; [1997]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

This paper presents methods which enable the use of passivity-based control design techniques to control non-passive systems. For inherently non-passive finite- dimensional linear time-invaraint systems, passification methods are presented to render such systems passive by suitable compensation. The passified system can then be controlled by a class of passive linear controllers. The idea is to exploit the robust stability properties of passivity-based control laws for uncertain systems. The proposed passification methods are demonstrated by application to the ACC benchmark problem and to pitch-axis control of an F-18 High Alpha Research Vehicle (HARV) model.
Author
Robustness (Mathematics); Control Systems Design; Linear Systems; Passivity

20040110253 NASA Langley Research Center, Hampton, VA, USA
Open-Loop HIRF Experiments Performed on a Fault Tolerant Flight Control Computer
Koppen, Daniel M.; [1997]; 7 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

During the third quarter of 1996, the Closed-Loop Systems Laboratory was established at the NASA Langley Research Center (LaRC) to study the effects of High Intensity Radiated Fields on complex avionic systems and control system components. This new facility provided a link and expanded upon the existing capabilities of the High Intensity Radiated Fields Laboratory at LaRC that were constructed and certified during 1995-96. The scope of the Closed-Loop Systems

Laboratory is to place highly integrated avionics instrumentation into a high intensity radiated field environment, interface the avionics to a real-time flight simulation that incorporates aircraft dynamics, engines, sensors, actuators and atmospheric turbulence, and collect, analyze, and model aircraft performance. This paper describes the layout and functionality of the Closed-Loop Systems Laboratory, and the open-loop calibration experiments that led up to the commencement of closed-loop real-time flight experiments.
Author
Fault Tolerance; Flight Control; Avionics; Feedback Control; Electromagnetic Fields; Computers

20040110282 NASA Langley Research Center, Hampton, VA, USA
Aeroservoelastic and Structural Dynamics Research on Smart Structures Conducted at NASA Langley Research Center
McGowan, Anna-Maria Rivas; Wilkie, W. Keats; Moses, Robert W.; Lake, Renee C.; Florance, Jennifer Pinkerton; Wieseman, Carol D.; Reaves, Mercedes C.; Taleghani, Barmac K.; Mirick, Paul H.; Wilbur, Mathew L.; [1997]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

An overview of smart structures research currently underway at the NASA Langley Research Center in the areas of aeroservoelasticity and structural dynamics is presented. Analytical and experimental results, plans, potential technology pay-offs, and challenges are discussed. The goal of this research is to develop the enabling technologies to actively and passively control aircraft and rotorcraft vibration and loads using smart devices. These enabling technologies and related research efforts include developing experimentally-validated finite element and aeroservoelastic modeling techniques; conducting bench experimental tests to assess feasibility and understand system trade-offs; and conducting large-scale wind tunnel tests to demonstrate system performance. The key aeroservoelastic applications of this research include: active twist control of rotor blades using interdigitated electrode piezoelectric composites and active control of flutter, and gust and buffeting responses using discrete piezoelectric patches. In addition, NASA Langley is an active participant in the DARPA/Air Force Research Laboratory/NASA/Northrop Grumman Smart Wing program which is assessing aerodynamic performance benefits using smart materials.
Author
Smart Structures; Aeroservoelasticity; Dynamic Structural Analysis

20040110354 NASA Langley Research Center, Hampton, VA, USA
Robust Multivariable Flutter Suppression for the Benchmark Active Control Technology (BACT) Wind-Tunnel Model
Waszak, Martin R.; [1997]; 13 pp.; In English; Eleventh Symposium on Structural Dynamics and Control, 12-14 May 1997, Blacksburg, VA, USA; No Copyright; Avail: CASI; A03, Hardcopy

The Benchmark Active Controls Technology (BACT) project is part of NASA Langley Research Center s Benchmark Models Program for studying transonic aeroelastic phenomena. In January of 1996 the BACT wind-tunnel model was used to successfully demonstrate the application of robust multivariable control design methods (H and -synthesis) to flutter suppression. This paper addresses the design and experimental evaluation of robust multivariable flutter suppression control laws with particular attention paid to the degree to which stability and performance robustness was achieved.
Author
Flutter Analysis; Robustness (Mathematics); Multivariable Control

20040110846 NASA Glenn Research Center, Cleveland, OH, USA
Evaluation of an Enhanced Bank of Kalman Filters for In-Flight Aircraft Engine Sensor Fault Diagnostics
Kobayashi, Takahisa; Simon, Donald L.; August 2004; 18 pp.; In English; Turbo Expo 2004, 14-17 Jun. 2004, Vienna, Austria
Contract(s)/Grant(s): WBS 22-728-30-05; DA Proj. 1L1-61102-AF-20
Report No.(s): NASA/TM-2004-213203; ARL-TR-3252; GT2004-53640; E-14712; No Copyright; Avail: CASI; A03, Hardcopy

In this paper, an approach for in-flight fault detection and isolation (FDI) of aircraft engine sensors based on a bank of Kalman filters is developed. This approach utilizes multiple Kalman filters, each of which is designed based on a specific fault hypothesis. When the propulsion system experiences a fault, only one Kalman filter with the correct hypothesis is able to maintain the nominal estimation performance. Based on this knowledge, the isolation of faults is achieved. Since the propulsion system may experience component and actuator faults as well, a sensor FDI system must be robust in terms of avoiding misclassifications of any anomalies. The proposed approach utilizes a bank of (m+1) Kalman filters where m is the number of sensors being monitored. One Kalman filter is used for the detection of component and actuator faults while each

of the other m filters detects a fault in a specific sensor. With this setup, the overall robustness of the sensor FDI system to anomalies is enhanced. Moreover, numerous component fault events can be accounted for by the FDI system. The sensor FDI system is applied to a commercial aircraft engine simulation, and its performance is evaluated at multiple power settings at a cruise operating point using various fault scenarios.
Author
Evaluation; Kalman Filters; Sensors; Fault Detection; Aircraft Engines

20040110948 Paper Pilot Research, Inc., Sterling, VA, USA, NASA Langley Research Center, Hampton, VA, USA
Modeling and Analysis of Large Amplitude Flight Maneuvers
Anderson, Mark R.; January 8, 2004; 62 pp.; In English
Contract(s)/Grant(s): NAS1-02048; 23-762-65-AG
Report No.(s): NASA/CR-2004-212994; No Copyright; Avail: CASI; A04, Hardcopy

Analytical methods for stability analysis of large amplitude aircraft motion have been slow to develop because many nonlinear system stability assessment methods are restricted to a state-space dimension of less than three. The proffered approach is to create regional cell-to-cell maps for strategically located two-dimensional subspaces within the higher-dimensional model statespace. These regional solutions capture nonlinear behavior better than linearized point solutions. They also avoid the computational difficulties that emerge when attempting to create a cell map for the entire state-space. Example stability results are presented for a general aviation aircraft and a micro-aerial vehicle configuration. The analytical results are consistent with characteristics that were discovered during previous flight-testing.
Author
Nonlinear Systems; Aerodynamic Stability; Systems Engineering; Stability Tests

20040110969 National Inst. of Aerospace, Hampton, VA, USA, NASA Langley Research Center, Hampton, VA, USA
Continuation Methods for Qualitative Analysis of Aircraft Dynamics
Cummings, Peter A.; July 2004; 24 pp.; In English
Contract(s)/Grant(s): NCC1-02043; 23-762-60-31
Report No.(s): NASA/CR-2004-213035; NIA-2004-06; No Copyright; Avail: CASI; A03, Hardcopy

A class of numerical methods for constructing bifurcation curves for systems of coupled, non-linear ordinary differential equations is presented. Foundations are discussed, and several variations are outlined along with their respective capabilities. Appropriate background material from dynamical systems theory is presented.
Author
Flight Characteristics; Dynamical Systems; Numerical Analysis; Aerodynamic Characteristics

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)*.

20040100770 NASA Langley Research Center, Hampton, VA, USA
National Transonic Facility Model and Tunnel Vibrations
Edwards, John W.; [1997]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Since coming online in 1984, the National Transonic Facility (NTF) cryogenic wind tunnel at the NASA Langley Research Center has provided unique high Reynolds number testing capability. While turbulence levels in the tunnel, expressed in terms of percent dynamic pressure, are typical of other transonic wind tunnels, the significantly increased load levels utilized to achieve flight Reynolds numbers, in conjunction with the unique structural design requirements for cryogenic operation, have brought forward the issue of model and model support structure vibrations. This paper reports new experimental measurements documenting aerodynamic and structural dynamics processes involved in such vibrations experienced in the NTF. In particular, evidence of local un-steady airloads developed about the model support strut is shown and related to well documented acoustic features known as 'Parker' modes. Two-dimensional unsteady viscous computations illustrate this model support structure loading mechanism.
Author
Transonic Wind Tunnels; Dynamic Structural Analysis; Dynamic Pressure; Aerodynamic Loads

20040110370 NASA Langley Research Center, Hampton, VA, USA

Enhanced Capabilities of the NASA Langley Thermal Acoustic Fatigue Apparatus

Rizzi, Stephen A.; Turner, Travis L.; Proceedings of the 6th International Congress on Recent Advances in Structural Dynamics; January 2004; Volume 2, pp. 919-933; In English; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents newly enhanced acoustic capabilities of the Thermal Acoustic Fatigue Apparatus at the NASA Langley Research Center. The facility is a progressive wave tube used for sonic fatigue testing of aerospace structures. Acoustic measurements for each of the six facility configurations are shown and comparisons with projected performance are made.

Author

Fatigue Tests; Aeroacoustics; Test Facilities

20040110860 NASA Langley Research Center, Hampton, VA, USA

Calibration of the Langley 8-Foot High Temperature Tunnel for Hypersonic Airbreathing Propulsion Testing

Huebner, Lawrence D.; Rock, Kenneth E.; Voland, Randall T.; Wieting, Allan R.; [1996]; 16 pp.; In English; 19th AIAA Advanced Measurement and Ground Testing Technology Conference, 17-20 Jun. 1996, New Orleans, LA, USA

Report No.(s): AIAA Paper 96-2197; Copyright; Avail: CASI; A03, Hardcopy

The NASA Langley 8-Foot High Temperature Tunnel has recently been modified to produce a unique testing capability for hypersonic airbreathing propulsion systems. Prior to these modifications, the facility was used primarily for aerothermal loads and structural verification testing at true flight total enthalpy conditions for Mach numbers between 6 and 7. One of the recent modifications was an oxygen replenishment system which allows operating airbreathing propulsion systems to be tested at true flight total enthalpies. Following the modifications to the facility, calibration runs were performed at total enthalpies corresponding to flight Mach numbers of 6.3 and 6.8 to establish the flow characteristics of the facility with its new capabilities. The results of this calibration, as well as modifications to tunnel combustor hardware prior to calibration to improve tunnel flow quality, are described in this paper.

Author

Hypersonic Wind Tunnels; High Temperature Tests; Calibrating

20040110959 NASA Langley Research Center, Hampton, VA, USA

Airborne-Managed Spacing in Multiple Arrival Streams

Barmore, Bryan; Abbott, Terence; Krishnamurthy, Karthik; [2004]; 9 pp.; In English; 24th International Congress of the Aeronautical Sciences (ICAS 2004), 29 Aug. - 4 Sep. 2004, Yokohama, Japan

Contract(s)/Grant(s): 727-10-00; No Copyright; Avail: CASI; A02, Hardcopy

A significant bottleneck in the current air traffic system occurs at the runway. Expanding airports and adding new runways will help solve this problem; however, this comes at a significant cost, financially, politically and environmentally. A complementary solution is to safely increase the capacity of current runways. This can be achieved by precise spacing at the runway threshold with a resulting reduction in the spacing buffer required under today s operations. At the NASA Langley Research Center, the Advanced Air Transportation Technologies (AATT) Project is investigating airborne technologies and procedures that will assist the pilot in achieving precise spacing behind another aircraft. This new spacing clearance instructs the pilot to follow speed cues from a new on-board guidance system called Airborne Merging and Spacing for Terminal Arrivals (AMSTAR). AMSTAR receives Automatic Dependent Surveillance-Broadcast (ADS-B) reports from the leading aircraft and calculates the appropriate speed for the ownership to fly in order to achieve the desired spacing interval, time or distance-based, at the runway threshold. Since the goal is overall system capacity, the speed guidance algorithm is designed to provide system benefit over individual efficiency. This paper discusses the concept of operations and design of AMSTAR to support airborne precision spacing. Results from the previous stage of development, focused only on in-trail spacing, are discussed along with the evolution of the concept to include merging of converging streams of traffic. This paper also examines how this operation might support future wake vortex-based separation and other advances in terminal area operations. Finally, the research plan for the merging capabilities, to be performed during the summer and fall of 2004 is presented.

Author

Air Traffic Control; Airports; Clearances; Runways

20040111001 NASA Stennis Space Center, Bay Saint Louis, MS, USA

Propulsion Ground Testing: Planning for the Future

Bruce, Robert; January 1, 2003; 4 pp.; In English; 41st AIAA Aerospace Sciences Meeting, 5-9 Jan. 2003, Reno, NV, USA

Report No.(s): AIAA Paper 2003-0278; SE-2003-01-00085-SSC; No Copyright; Avail: CASI; A01, Hardcopy

Advanced planners are constantly being asked to plan for the provision of future test capability. Historically, this capability is provided either by substantial investment in new test facility capabilities, or in the substantial investment in the modification of pre- existing test capabilities. The key words in the previous sentence are 'substantial investment". In the evolving environment of increasingly constrained resources, how is an advanced planner to plan for the provisions of such capabilities? Additionally, the conundrum exists that program formulation decisions are being made based upon both life cycle cost decisions in an environment in which the more immediate challenge of 'front-end' capital investment? Often times is the linch-pin upon which early decisions are made. In such an environment, how are plans and decisions made? This paper cites examples of decisions made in the past in the area of both major test facility upgrades, as well as major new test facility investment.
Author
Propulsion; Ground Tests; Life Cycle Costs

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*.

20040100687 President's Commission on Implementation of USA Space Exploration Policy, Washington, DC, USA
Journey to Inspire, Innovate, and Discover. Moon, Mars and Beyond
Jun. 2004; In English
Report No.(s): PB2004-106030; No Copyright; Avail: National Technical Information Service (NTIS)

On January 14, 2004, President Bush announced a new vision for the USA civil space program based upon exploration of the Moon, Mars, and beyond. The Executive Order signed on January 27, 2004, created a Commission to examine and make recommendations on implementing this new vision and the Commission was asked to submit its report 120 days after its first meeting. Accordingly, this is the Commission's final report. The Commission sought extensive input for its deliberations, from within the U.S. government and directly from the public in the USA and abroad. We held five televised public hearings, meeting in: Washington, D.C.; Dayton, Ohio; Atlanta, Georgia; San Francisco, California; and New York City. We heard public testimony from 96 individuals representing academia, industry, media, teachers, students, entrepreneurs, astronauts, labor unions, state governments, federal government agencies, international space agencies, and professional associations. The Commission's web site received more than 6 million hits and over 6,000 written inputs. Public comments strongly supported the new space vision, by a 7-to-1 ratio.
NTIS
Space Programs; Governments

20040100699 General Accounting Office, Washington, DC
Defense Space Activities. Additional Actions Needed to Implement Human Capital Strategy and Develop Space Personnel
Aug. 2004; 38 pp.; In English
Report No.(s): PB2004-107021; GAO-04-697; No Copyright; Avail: CASI; A03, Hardcopy

The Department of Defense (DOD) relies on space for many critical capabilities, and its continued success in space operations depends on having sufficient space-qualified personnel. Space-qualified personnel are needed to develop technology, doctrine, and concepts and operate complex systems. In the National Defense Authorization Act for Fiscal Year 2004, Congress required DOD to develop a strategy for developing and integrating national security space personnel. DOD completed it in February 2004. Congress also required GAO to assess DOD's space human capital strategy and the military services' efforts to develop their space personnel. In the first of two required reports, GAO assessed (1) whether DOD's space human capital strategy and management approach promote development and integration of the services' space personnel and (2) the extent of the services' initiatives to develop and manage their space personnel.
NTIS
Personnel Management; Personnel Development

20040110971 NASA Marshall Space Flight Center, Huntsville, AL, USA
Transformational Systems Concepts and Technologies for Our Future in Space
Howell, J. T.; George,P.; Mankins, J. C., Editor; Christensen, C. B.; June 2004; 45 pp.; In English; Transformational Systems Concepts and Technologies for Our Future in Space Workshop, 17-19 Jun. 2003, Huntsville, AL, USA
Report No.(s): NASA/CP-2004-213229; M-1112; No Copyright; Avail: CASI; A03, Hardcopy

NASA is constantly searching for new ideas and approaches yielding opportunities for assuring maximum returns on space infrastructure investments. Perhaps the idea of transformational innovation in developing space systems is long overdue. However, the concept of utilizing modular space system designs combined with stepping-stone development processes has merit and promises to return several times the original investment since each new space system or component is not treated as a unique and/or discrete design and development challenge. New space systems can be planned and designed so that each builds on the technology of previous systems and provides capabilities to support future advanced systems. Subsystems can be designed to use common modular components and achieve economies of scale, production, and operation. Standards, interoperability, and 'plug and play' capabilities, when implemented vigorously and consistently, will result in systems that can be upgraded effectively with new technologies. This workshop explored many building-block approaches via way of example across a broad spectrum of technology discipline areas for potentially transforming space systems and inspiring future innovation. Details describing the workshop structure, process, and results are contained in this Conference Publication.
Author
Aerospace Systems; Interoperability; Support Systems

13
ASTRODYNAMICS

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

20040110662 NASA Langley Research Center, Hampton, VA, USA
Relative Navigation In Elliptical Orbits Using An Iterative Nonlinear Filter
Garrison, James L.; Axelrad, Penina; [1997]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The two step filter is applied to process intersatellite radar measurements to determine the motion of one satellite relative to another in close elliptical orbits. This filter breaks a nonlinear estimation problem into two state vectors. The 'first step' state is chosen so as to have a linear measurement equation. This is nonlinearly related to the 'second step' state which describes the dynamics. Two different forms are used. In one, the first step state is the second step state vector augmented by the measurement equation. In the other, the first step and second step state vectors are of equal dimension. The two step filter is compared against an iterated extended Kalman filter and a Kalman filter using a change of variables. Analytical differences between the two step estimator and these conventional filters are highlighted. Special concerns for initializing the first step state covariance matrix and handling the possibility of numerically rank deficient covariance matrices are addressed. Numerical simulations are performed which show that the Two Step estimator produces a lower estimation bias under two circumstances; large apriori initial error; and small dimension observation vectors which require a longer arc of measurements to generate observability of the state.
Author
Space Navigation; Nonlinear Filters; Orbit Calculation; Radar Measurement; Satellite Orbits

14
GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

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

20040095904 NASA Dryden Flight Research Center, Edwards, CA, USA
Mobile Aerial Tracking and Imaging System (MATrIS) for Aeronautical Research
Banks, Daniel W.; Blanchard, Robert C.; Miller, Geoffrey M.; August 2004; 18 pp.; In English; 11th International Symposium on Flow Visualization, 9-12 Aug. 2004, Notre Dame, IN, USA
Contract(s)/Grant(s): NAS4-156; NASA Order EO-5557-D; 090-20-00-GA-XR
Report No.(s): NASA/TM-2004-212852; H-2561; No Copyright; Avail: CASI; A03, Hardcopy

A mobile, rapidly deployable ground-based system to track and image targets of aeronautical interest has been developed. Targets include reentering reusable launch vehicles as well as atmospheric and transatmospheric vehicles. The optics were designed to image targets in the visible and infrared wavelengths. To minimize acquisition cost and development time, the system uses commercially available hardware and software where possible. The conception and initial funding of this system originated with a study of ground-based imaging of global aerothermal characteristics of reusable launch vehicle configurations. During that study the National Aeronautics and Space Administration teamed with the Missile Defense Agency/Innovative Science and Technology Experimentation Facility to test techniques and analysis on two Space Shuttle flights.
Author
Transatmospheric Vehicles; Reusable Launch Vehicles; Targets; Imaging Techniques; Computer Programs

20040110406 NASA Langley Research Center, Hampton, VA, USA
Virtual Instrument Simulator for CERES
Chapman, John J.; [1997]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

A benchtop virtual instrument simulator for CERES (Clouds and the Earth's Radiant Energy System) has been built at NASA, Langley Research Center in Hampton, VA. The CERES instruments will fly on several earth orbiting platforms notably NASDA's Tropical Rainfall Measurement Mission (TRMM) and NASA's Earth Observing System (EOS) satellites. CERES measures top of the atmosphere radiative fluxes using microprocessor controlled scanning radiometers. The CERES Virtual Instrument Simulator consists of electronic circuitry identical to the flight unit's twin microprocessors and telemetry interface to the supporting spacecraft electronics and two personal computers (PC) connected to the I/O ports that control azimuth and elevation gimbals. Software consists of the unmodified TRW developed Flight Code and Ground Support Software which serves as the instrument monitor and NASA/TRW developed engineering models of the scanners. The CERES Instrument Simulator will serve as a testbed for testing of custom instrument commands intended to solve in-flight anomalies of the instruments which could arise during the CERES mission. One of the supporting computers supports the telemetry display which monitors the simulator microprocessors during the development and testing of custom instrument commands. The CERES engineering development software models have been modified to provide a virtual instrument running on a second supporting computer linked in real time to the instrument flight microprocessor control ports. The CERES Instrument Simulator will be used to verify memory uploads by the CERES Flight Operations TEAM at NASA. Plots of the virtual scanner models match the actual instrument scan plots. A high speed logic analyzer has been used to track the performance of the flight microprocessor. The concept of using an identical but non-flight qualified microprocessor and electronics ensemble linked to a virtual instrument with identical system software affords a relatively inexpensive simulation system capable of high fidelity.
Author
Simulators; Satellite-Borne Instruments

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*.

20040095912 NASA Langley Research Center, Hampton, VA, USA, Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Mars Exploration Rovers Entry, Descent, and Landing Trajectory Analysis
Desai, Prasun N.; Knocke, Philip C.; August 11, 2004; 8 pp.; In English; AIAA/AAS Astrodnamics Specialist Conference and Exhibit, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 23-749-30-00
Report No.(s): AIAA Paper 2004-5092; No Copyright; Avail: CASI; A02, Hardcopy

The Mars Exploration Rover mission successfully landed two rovers 'Spirit' and 'Opportunity' on Mars on January 4th and 25th of 2004, respectively. The trajectory analysis performed to define the entry, descent, and landing (EDL) scenario is described. The entry requirements and constraints are presented, as well as uncertainties used in a Monte Carlo dispersion analysis to statistically assess the robustness of the entry design to off-nominal conditions. In the analysis, six-degree-of-freedom and three-degree-of-freedom trajectory results are compared to assess the entry characteristics of the capsule. Comparison of the preentry results to preliminary post-landing reconstruction data shows that all EDL parameters were within

the requirements. In addition, the final landing position for both 'Spirit' and 'Opportunity' were within 15 km of the predicted landing location.
Author
Trajectory Analysis; Mars Landing; Roving Vehicles; Position (Location)

20040095913 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Mars Exploration Rovers Landing Dispersion Analysis
Knocke, Philip C.; Wawrzyniak, Geoffrey G.; Kennedy, Brian M.; Desai, Prasun N.; Parker, TImothy J.; Golombek, Matthew P.; Duxbury, Thomas C.; Kass, David M.; [2004]; 17 pp.; In English
Report No.(s): AIAA Paper 2004-5093; No Copyright; Avail: CASI; A03, Hardcopy

Landing dispersion estimates for the Mars Exploration Rover missions were key elements in the site targeting process and in the evaluation of landing risk. This paper addresses the process and results of the landing dispersion analyses performed for both Spirit and Opportunity. The several contributors to landing dispersions (navigation and atmospheric uncertainties, spacecraft modeling, winds, and margins) are discussed, as are the analysis tools used. JPL's MarsLS program, a MATLAB-based landing dispersion visualization and statistical analysis tool, was used to calculate the probability of landing within hazardous areas. By convolving this with the probability of landing within flight system limits (in-spec landing) for each hazard area, a single overall measure of landing risk was calculated for each landing ellipse. In-spec probability contours were also generated, allowing a more synoptic view of site risks, illustrating the sensitivity to changes in landing location, and quantifying the possible consequences of anomalies such as incomplete maneuvers. Data and products required to support these analyses are described, including the landing footprints calculated by NASA Langley's POST program and JPL's AEPL program, cartographically registered base maps and hazard maps, and flight system estimates of in-spec landing probabilities for each hazard terrain type. Various factors encountered during operations, including evolving navigation estimates and changing atmospheric models, are discussed and final landing points are compared with approach estimates.
Author
Mars Exploration; Landing Modules; Roving Vehicles; Statistical Analysis; Land

20040095930 NASA Langley Research Center, Hampton, VA, USA
Modeling and Simulation of Reliability & Maintainability Parameters for Reusable Launch Vehicles using Design of Experiments
Unal, Resit; Morris, W. Douglas; White, Nancy H.; Lepsch, Roger A.; [2004]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

This paper describes the development of a methodology for estimating reliability and maintainability distribution parameters for a reusable launch vehicle. A disciplinary analysis code and experimental designs are used to construct approximation models for performance characteristics. These models are then used in a simulation study to estimate performance characteristic distributions efficiently. The effectiveness and limitations of the developed methodology for launch vehicle operations simulations are also discussed.
Author
Reusable Launch Vehicles; Reliability; Maintainability; Simulation

20040095937 NASA Langley Research Center, Hampton, VA, USA
Aerodynamic Characteristics and Glide-Back Performance of Langley Glide-Back Booster
Pamadi, Bandu N.; Covell, Peter F.; Tartabini, Paul V.; Murphy, Kelly J.; August 13, 2004; 17 pp.; In English; 22nd AIAA Applied Aerodynamics Conference and Exhibit, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 794-40-3R
Report No.(s): AIAA Paper 2004-5382; No Copyright; Avail: CASI; A03, Hardcopy

NASA-Langley Research Center is conducting system level studies on an-house concept of a small launch vehicle to address NASA's needs for rapid deployment of small payloads to Low Earth Orbit. The vehicle concept is a three-stage system with a reusable first stage and expendable upper stages. The reusable first stage booster, which glides back to launch site after staging around Mach 3 is named the Langley Glide-Back Booster (LGBB). This paper discusses the aerodynamic characteristics of the LGBB from subsonic to supersonic speeds, development of the aerodynamic database and application of this database to evaluate the glide back performance of the LGBB. The aerodynamic database was assembled using a combination of wind tunnel test data and engineering level analysis. The glide back performance of the LGBB was evaluated

using a trajectory optimization code and subject to constraints on angle of attack, dynamic pressure and normal acceleration. Author

Aerodynamic Characteristics; Launch Vehicles; Boostglide Vehicles; Wind Tunnel Tests; Trajectory Analysis

20040095959 NASA Langley Research Center, Hampton, VA, USA

Simulation and Analyses of Staging Maneuvers of Next Generation Reusable Launch Vehicles

Pamadi, Bandu N.; Neirynck, Thomas A.; Covell, Peter F.; Hotchko, Nathaniel; Bose, David; [2004]; 19 pp.; In English; AIAA Atmospheric Flight Mechanics Conference and Exhibit, 16-19 Aug. 2004, Providence, RI, USA

Contract(s)/Grant(s): 23-794-40-3R

Report No.(s): AIAA Paper 2004-5185; No Copyright; Avail: CASI; A03, Hardcopy

NASA has initiated a comprehensive stage separation tool development activity to address the technology needed for successful development and operation of next generation reusable launch vehicles. As a part of this activity, ConSep simulation tool is being developed. This paper discusses the application of this tool to the staging maneuvers of two-stage-to-orbit (TSTO) vehicles. Simulation and analyses are performed for two bimese TSTO concepts, one staging at Mach 3 and the other at Mach 6. The TSTO bimese vehicles used in this study are sized for international space station class payload. The proximity and isolated aerodynamic databases used in the simulation were generated using the data from wind tunnel tests conducted at NASA Langley Research Center. ConSep is a MATLAB-based front end to the commercially available ADAMS solver, an industry standard package for solving multi-body dynamic problems.

Author

Stage Separation; Reusable Launch Vehicles; Multistage Rocket Vehicles; Computerized Simulation; Wind Tunnel Tests

20040110463 Defense Communications Agency, Arlington, VA

Architectural Trends in Military Satellite Communications Systems

Jain, Pravin C.; Jul. 1990; 14 pp.; In English

Report No.(s): AD-A425230; No Copyright; Avail: CASI; A03, Hardcopy

Military communication via satellites has grown rapidly in the past 20 years. During this period, military systems have progressed through a family of increasingly more capable satellites and have arrived at a very mature state. The article begins with a historical overview of military communications by satellite and a detailed description of current systems. Next, the capabilities of present systems are reviewed in relation to user requirements and threats. The author contends that use of satellite communications by a large number of small-terminal users (e.g., aircraft, ships, submarines, and land mobiles) still requires major technological innovations to meet the need for a substantial increase in system capacity and performance improvement in a jamming environment. High-gain satellite antennas with many simultaneous spot beams and onboard signal processing are the two important areas of technology for alleviating the shortcomings of present systems. While it is possible to implement these features at ultrahigh frequencies and superhigh frequencies, the desire to support communications in a stressed environment strongly favors the use of even higher frequencies. The next-generation systems of the 1990s are reviewed with an emphasis on extremely high frequency systems and architectural trends for the post-2000 era. Alternative directions for future systems development, such as the use of highly proliferated satellite constellations, also are explored. (11 figures, 8 refs.)

DTIC

Communication Satellites; Military Spacecraft; Satellite Communication; Trends

20040110506 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA

Vibration Analysis and Control of an Inflatable Structure Using Smart Materials

Inman, Daniel J.; Aug. 2004; 8 pp.; In English

Contract(s)/Grant(s): F49620-03-1-0163

Report No.(s): AD-A425363; No Copyright; Avail: CASI; A02, Hardcopy

Lightweight inflatable structures, or Gossamer spacecraft, are very attractive in aerospace applications for several reasons. These structures pose difficult problems, however, in modeling and in control due to their special geometry and material properties. Initially, the proposed work was to examine the nonlinear structural dynamics of an inflated torus with a membrane attached to it for the purpose of providing suitable models for the application of nonlinear control. This work/award commenced in April 2003. In March 2004, after a site visit by the AFOSR Program Manager, the focus of this effort was changed to correspond more closely with AFRL interests. In particular, after conversations with AFRL/DEBS and AFRL/VSSV, both of Kirtland AFB, the focus of the proposed effort was changed to examine the structural dynamics of a

pressurized membrane with the goal of providing a sound modeling and theoretical understanding of the coupled structure, fluid, optical and control hardware of AFRL/DEBS's proposed system. The following is a brief report of our activities over 11 months of funding. The section numbers correspond to the categories requested on the AFOSR website for progress reports.
DTIC
Aerospace Systems; Control Systems Design; Controllers; Dynamic Structural Analysis; Inflatable Structures; Smart Materials

20040110893 NASA Langley Research Center, Hampton, VA, USA
DSMC Grid Methodologies for Computing Low-Density, Hypersonic Flows About Reusable Launch Vehicles
Wilmoth, Richard G.; LeBeau, Gerald J.; Carlson, Ann B.; [1996]; 12 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Two different grid methodologies are studied for application to DSMC simulations about reusable launch vehicles. One method uses an unstructured, tetrahedral grid while the other uses a structured, variable-resolution Cartesian grid. The relative merits of each method are discussed in terms of accuracy, computational efficiency, and overall ease of use. Both methods are applied to the computation of a low-density, hypersonic flow about a winged single-stage-to-orbit reusable launch vehicle concept at conditions corresponding to an altitude of 120 km. Both methods are shown to give comparable results for both surface and flowfield quantities as well as for the overall aerodynamic behavior. For the conditions simulated, the flowfield about the vehicle is very rarefied but the DSMC simulations show significant departure from free-molecular predictions for the surface friction and heat transfer as well as certain aerodynamic quantities.
Author
Computerized Simulation; Grid Computing (Computer Networks); Hypersonic Flow; Monte Carlo Method; Reusable Launch Vehicles; Computational Fluid Dynamics; Low Density Flow

17
SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

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

20040105579 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Building a Reliable Onboard Network with Ethernet: A GSFC Prototype
Marquart, Jane; [2004]; 14 pp.; In English; Fourth Annual Space Internet Workshop, 8-10 Jun. 2004, Hanover, MD, USA; No Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation discusses the architecture of an Ethernet-based communication network for spacecraft. The presentation also contains information on data link reliability, PDU formats, and NIC/OS Measurements.
CASI
Spacecraft Communication; Ethernet; Communication Networks

20040105615 NASA Glenn Research Center, Cleveland, OH, USA
Optimizing Satellite Communications With Adaptive and Phased Array Antennas
Ingram, Mary Ann; Romanofsky, Robert; Lee, Richard Q.; Miranda, Felix; Popovic, Zoya; Langley, John; Barott, William C.; Ahmed, M. Usman; Mandl, Dan; [2004]; 7 pp.; In English; ESTC 2004, 21-23 Jun. 2004, Palo Alto, CA, USA; No Copyright; Avail: CASI; A02, Hardcopy

A new adaptive antenna array architecture for low-earth-orbiting satellite ground stations is being investigated. These ground stations are intended to have no moving parts and could potentially be operated in populated areas, where terrestrial interference is likely. The architecture includes multiple, moderately directive phased arrays. The phased arrays, each steered in the approximate direction of the satellite, are adaptively combined to enhance the Signal-to-Noise and Interference-Ratio (SNIR) of the desired satellite. The size of each phased array is to be traded-off with the number of phased arrays, to optimize cost, while meeting a bit-error-rate threshold. Also, two phased array architectures are being prototyped: a spacefed lens array and a reflect-array. If two co-channel satellites are in the field of view of the phased arrays, then multi-user detection techniques may enable simultaneous demodulation of the satellite signals, also known as Space Division Multiple Access (SDMA). We report on Phase I of the project, in which fixed directional elements are adaptively combined in a prototype to demodulate the S-band downlink of the EO-1 satellite, which is part of the New Millennium Program at NASA.
Author
Antenna Arrays; Phased Arrays; Satellite Communication; Adaptive Control; Optimization; Antenna Design

20040110335 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Navigation Flight Operations for Mars Pathfinder
Vaughan, Robin M.; Kallemeyn, Pieter H., Jr.; Spencer, David A.; Braun, Robert D.; January 2004; 20 pp.; In English
Report No.(s): AAS-98-145; No Copyright; Avail: CASI; A03, Hardcopy

On July 4, 1997, Mars Pathfinder became the first spacecraft to land on the surface of Mars in 21 years. Pathfinder was launched on December 4, 1996 and spent seven months en route to the red planet. This report discusses the navigation flight experience for the Mars Pathfinder interplanetary cruise. In particular, orbit determination and maneuver design and execution results are presented. Special emphasis is given to the navigation role in the days and hours leading up to and including the Entry, Descent, and Landing (EDL) phase.
Author
Flight Operations; Mars Pathfinder; Mars Surface; Navigation

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*.

20040095915 NASA Langley Research Center, Hampton, VA, USA
Carbon-Carbon Composite Radiator Development for the EO-1 Spacecraft
Vaughn, Wallace; Shinn, Elizabeth; Rawal, Suraj; Wright, Joe; [2004]; 16 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The Carbon-Carbon Space Radiator Partnership (CSRP), an informal partnership of Government and industrial personnel, was formed to promote the use of Carbon-carbon composites (C-C) as engineering materials for spacecraft thermal management applications . As a part of this effort the partnership has built a structural radiator for the Earth Orbiter - 1 (EO-1) spacecraft. This radiator, using C-C face-sheets with an aluminum honeycomb core, will demonstrate both the thermal and structural properties of C-C under actual service conditions as well as provide performance data from space flight. This paper will present results from the design of the radiator, the thermal/mechanical tests of the facesheet materials, and sub-component test results on the C-C/Al honeycomb sandwich material. The 29- by 28-inch radiator was designed to support two electronics boxes with a combined heat output of 60 watts maximum and a weight of 58 lbs. The analysis of the radiator design shows that the radiator constructed with 20-mil-thick facesheets of a P30-fiber-reinforced C-C from BFGoodrich is able to meet or exceed all the required thermal and mechanical requirements.
Author
Carbon-Carbon Composites; Temperature Control; Thermodynamic Properties; Spacecraft Radiators

20040095916 NASA Langley Research Center, Hampton, VA, USA
Force, Surface Pressure, and Flowfield Measurements on a Slender Missile Configuration with Square Cross-Section at Supersonic Speeds
Wilcox, Floyd J., Jr.; Birch, Trevor J.; Allen, Jerry M.; August 6, 2004; 26 pp.; In English; 22nd AIAA Applied Aerodynamics Conference and Exhibit, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 090-20-35
Report No.(s): AIAA Paper 2004-5451; No Copyright; Avail: CASI; A03, Hardcopy

A wind-tunnel investigation of a square cross-section missile configuration has been conducted to obtain force and moment measurements, surface pressure measurements, and vapor screen flow visualization photographs for comparison with computational fluid dynamics studies conducted under the auspices of The Technical Cooperation Program (TTCP). Tests were conducted on three configurations which included: (1) body alone, (2) body plus tail fins mounted on the missile corners, and (3) body plus tail fins mounted on the missile side. This test was conducted in test section #2 of the NASA Langley Unitary Plan Wind Tunnel at Mach numbers of 2.50 and 4.50 and at a Reynolds number of 4 million per ft. The data were obtained over an angle of attack range from -4 deg. to 24 deg. and roll angles from 0 deg. to 45 deg., i.e., from a diamond shape (as

viewed from the rear) at a roll angle of 0 deg. to a square shape at 45 deg.
Author
Wind Tunnel Tests; Computational Fluid Dynamics; Cross Sections; Missile Configurations; Missile Bodies; Pressure Measurement; Supersonic Speed

20040095922 NASA Langley Research Center, Hampton, VA, USA
Reusable Metallic Thermal Protection Systems Development
Blosser, Max L.; Martin, Carl J.; Daryabeigi, Kamran; Poteet, Carl C.; [1998]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Metallic thermal protection systems (TPS) are being developed to help meet the ambitious goals of future reusable launch vehicles. Recent metallic TPS development efforts at NASA Langley Research Center are described. Foil-gage metallic honeycomb coupons, representative of the outer surface of metallic TPS were subjected to low speed impact, hypervelocity impact, rain erosion, and subsequent arcjet exposure. TPS panels were subjected to thermal vacuum, acoustic, and hot gas flow testing. Results of the coupon and panel tests are presented. Experimental and analytical tools are being developed to characterize and improve internal insulations. Masses of metallic TPS and advanced ceramic tile and blanket TPS concepts are compared for a wide range of parameters.
Author
Ceramics; Hypervelocity Impact; Reusable Launch Vehicles; Thermal Protection

20040100753 NASA Langley Research Center, Hampton, VA, USA
Isolated Roughness Induced Boundary-Layer Transition: Shuttle Orbiter Ground Tests and Flight Experience
Bouslog, Stanley A.; Bertin, John J.; Berry, Scott A.; Caram, Jose M.; [1997]; 18 pp.; In English; 35th Aerospace Sciences Meeting and Exhibit, 6-10 Jan. 1997, Reno, NV, USA
Report No.(s): AIAA Paper 97-0274; Copyright; Avail: CASI; A03, Hardcopy

Recent Orbiter wind tunnel data and flight data have been used to evaluate boundary-layer transition induced by discrete-roughness elements on the Orbiter windward surface. Orbiter flow field calculations have been used to compute transition parameters and disturbance parameters for correlating the results and comparing the trends. Existing transition correlations have been modified and applied to the Orbiter. These correlations provide a means to predict transition on the Orbiter given a known isolated roughness element. Furthermore, these data and data reduction methods provide information and guidance for the prediction of transition due to &screte-roughness elements on future winged reentry vehicles.
Author
Surface Roughness; Reentry Vehicles; Ground Tests; Flow Distribution; Boundary Layer Transition

20040100756 NASA Langley Research Center, Hampton, VA, USA
Mars Microprobe Entry Analysis
Braun, Robert D.; Mitcheltree, Robert A.; Cheatwood, F. McNeil; [1998]; 15 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The Mars Microprobe mission will provide the first opportunity for subsurface measurements, including water detection, near the south pole of Mars. In this paper, performance of the Microprobe aeroshell design is evaluated through development of a six-degree-of-freedom (6-DOF) aerodynamic database and flight dynamics simulation. Numerous mission uncertainties are quantified and a Monte-Carlo analysis is performed to statistically assess mission performance. Results from this 6-DOF Monte-Carlo simulation demonstrate that, in a majority of the cases (approximately 2-sigma), the penetrator impact conditions are within current design tolerances. Several trajectories are identified in which the current set of impact requirements are not satisfied. From these cases, critical design parameters are highlighted and additional system requirements are suggested. In particular, a relatively large angle-of-attack range near peak heating is identified.
Author
Mars Missions; NASA Space Programs; Atmospheric Entry; Computational Fluid Dynamics; Spacecraft Design; Space Probes; Dynamic Control

20040100776 NASA Langley Research Center, Hampton, VA, USA
Enhanced Control Effector Designs for Airbreathing Transatmospheric Vehicles
Cockrell, Charles E.; McMinn, John D.; [1997]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

A study was conducted to evaluate the potential effectiveness of a moveable cowl-trailing-edge design for airbreathing

hypersonic single-stage-to-orbit (SSTO) configurations, which can be extended or deflected from the nominal position in order to provide additional pitching moment capability. This additional pitching moment capability may reduce the necessary deflection angle from conventional control surfaces and the associated trim drag penalty. Calculations for a generic SSTO configuration with baseline and modified cowl trailing edge geometries were performed at Mach 6 and 10 initially with an engineering analysis code in order to examine several design parametrics. In order to more accurately model geometries and flow physics, 2-D viscous computational fluid dynamics (CFD) predictions were obtained. FInally, a limited set of 3D CFD predictions were obtained at Mach 6 in order to show the effects of modeling 3D flow fields as well as the full 3D vehicle geometry. Comparisons of aftbody surface pressures and force and moment predictions show differences between initial predictions and 2-D CFD solutions due to geometry modeling and calculation method differences. The 3-D CFD predictions confirm the trends observed in the 2-D solutions and provide additional information on 3D effects. These analyses shows that cowl-trailing-edge extensions were effective in providing additional (nose-down) pitching moment increments as well as increased thrust compared to the baseline geometry. These effects reduce the control surface deflection angle required to trim the vehicle and the associated trim drag. Cowl-trailingedge deflections were not as effective, generating more nose-up pitching moment and decreased thrust compared to non-deflected cases.
Author
Evaluation; Air Breathing Engines; Transatmospheric Vehicles; Flow Distribution; Fluid Dynamics; Computational Fluid Dynamics

20040100803 NASA Langley Research Center, Hampton, VA, USA
Measured Spacecraft Dynamic Effects on Atmospheric Science Instruments
Woodard, Stanley E.; Gell, David A.; Lay, Richard R.; [1997]; 10 pp.; In English
Report No.(s): AIAA Paper 97-0419; Copyright; Avail: CASI; A02, Hardcopy

On September 1991, NASA launched the Upper Atmosphere Research Satellite. In addition to its atmospheric science mission, spacecraft dynamic effects on science measurements were analyzed. The investigation included two in-flight experiments to determine how each on-board instrument, subsystem and environmental disturbance contributed to the spacecraft dynamic response and how these disturbances affected science measurements. Three case studies are presented which show the impact of spacecraft dynamic response on science measurements. In the first case, correlation of independent atmospheric meridional wind measurements taken by two instruments with the spacecraft dynamic response demonstrated that excessive vibration (exceeding instrument pointing requirements) resulted in wind measurement disagreement. In the second case, solar array disturbances produced a spacecraft response signature on radiometer measurements. The signature explicitly demonstrated that if an instrument has sufficient spatial and temporal resolution, spacecraft dynamic response could impact measurements. In the final case, correlation of an instrument's fine sun sensor data and CO2 measurements demonstrated the effect of temporal and spatial sampling resolution and active pointing control on science measurements. The sun sensor had a frequency modulated characteristic due to spacecraft vibration and the periodic scanning of another instrument which was not present on the CO2 measurements.
Author
Pointing Control Systems; Dynamic Response; Frequency Modulation; Radiometers; Solar Arrays; Solar Sensors

20040100806 NASA Langley Research Center, Hampton, VA, USA
Dual Mode Shock-Expansion/Reflected-Shock Tunnel
Erdos, John I.; Bakos, Robert J.; Castrogiovanni, Anthony; Rogers, R. Clayton; [1998]; 21 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

NASA s HYPULSE facility at GASL has been reconfigured to permit free jet testing of the Hyper-X flowpath at flight Mach numbers of 7 and 10. Among the required changes are addition of a converging-diverging nozzle to permit operation in a reflected shock tunnel mode, a 7 ft. diameter test cabin and a 30 in. diameter contoured nozzle. However, none of these changes were allowed to interfere with rapid recovery of the prior shock-expansion tunnel mode of operation, and indeed certain changes should enhance facility usefulness and productivity in either mode. A previously-developed shock-induced detonation mode of driving the facility has been successfully applied to both reflected shock tunnel operation at Mach 10 flight conditions, with tailored interface operation, and shock-expansion tunnel operation at flight conditions corresponding to Mach numbers from 12 to 25. Tailored interface operation at Mach 7 has been achieved with an unheated helium driver. In the present paper, the rationale for a dual mode shock expansion/reflected shock tunnel is discussed, and the capabilities and limitations for each mode are outlined. The physical changes in the HYPULSE facility to achieve dual mode capability are also described. Limited calibration data obtained to date in the new reflected shock tunnel mode are presented and the

anticipated flight simulation map with dual mode operation is also outlined.
Author
Shock Tunnels; Convergent-Divergent Nozzles; Flight Conditions; Flight Simulation

20040100807 NASA Langley Research Center, Hampton, VA, USA
Overview of X-38 Hypersonic Wind Tunnel Data and Comparison with Numerical Results
Campbell, Charles H.; Caram, Jose; Berry, Scott; DiFulvio, Michael; Horvath, Tom; [1997]; 12 pp.; In English; 35th Aerospace Sciences Meeting and Exhibit, 6-10 Jan. 1997, Reno, NV, USA
Report No.(s): AIAA Paper 97-0567; Copyright; Avail: CASI; A03, Hardcopy

A NASA team of engineers has been organized to design a crew return vehicle for returning International Space Station crew members from orbit. The hypersonic characteristics of this X-23/X-2&4 derived crew return vehicle (designated X-38) are being evaluated in various wind tunnels in support of this effort. Aerodynamic data has been acquired in three NASA hypersonic facilities at Mach 20, and Mach 6. Computational Fluid Dynamics tools have been applied at the appropriate wind tunnel conditions to make comparisons with portions of this data. Experimental data from the Mach 6 Air and CF4 facilities illustrate a net positive pitching moment increment due to density ratio, as well as increased elevon effectiveness. Chemical nonequilibrium computational fluid dynamics solutions at flight conditions reinforce this conclusion.
Author
X-38 Crew Return Vehicle; Wind Tunnel Tests; Data Acquisition; Numerical Analysis; Computational Fluid Dynamics; Flight Conditions

20040105628 NASA Langley Research Center, Hampton, VA, USA
Aerodynamics of the Mars Microprobe Entry Vehicles
Mitcheltree, R. A.; Moss, J. N.; Cheatwood, F. M.; Greene, F. A.; Braun, R. D.; [1997]; 11 pp.; In English
Report No.(s): AIAA Paper 97-3658; Copyright; Avail: CASI; A03, Hardcopy

The selection of the unique aeroshell shape for the Mars Microprobes is discussed. A description of its aerodynamics in hypersonic rarefied, hypersonic continuum, supersonic and transonic flow regimes is then presented. This description is based on Direct Simulation Monte Carlo analyses in the rarefied-flow regime, thermochemical nonequilibrium Computational Fluid Dynamics in the hypersonic regime, existing wind tunnel data in the supersonic and transonic regime, additional computational work in the transonic regime, and finally, ballistic range data. The aeroshell is shown to possess the correct combination of aerodynamic stability and drag to convert the probe's initial tumbling attitude and high velocity at atmospheric-interface into the desired surface-impact orientation and velocity.
Author
Aerodynamic Stability; Aerospace Vehicles; Impact Velocity; Supersonic Flow; Computational Fluid Dynamics

20040110260 Lockheed Martin Corp., USA
Efficient Calculation of a Jitter/Stability Metric
Giesy, Daniel P.; AIAA Journal of Spacecraft and Rockets; [1997]; 31 pp.; In English
Contract(s)/Grant(s): NAS1-19000; NAS1-96014; No Copyright; Avail: CASI; A03, Hardcopy

A tool for computing a jitter/stability metric used in NASA requirements statements is developed. An efficient algorithm is given for computing this metric. Two ways of implementing it on a computer are discussed. One is optimized for computational speed while the other sacrifices some speed to conserve memory. Timing studies are given to show that the improvement of computation times using the present algorithm over previously existing techniques can run to several orders of magnitude, and that previous techniques were so costly that the present algorithm represents enabling technology. Further comparisons show that the memory conservative implementation runs at about half the speed of the fast implementation, but can cut the major data storage requirement of the fast implementation by 95-99%, making the algorithm implementable on much smaller computers, such as PC's, than it would be otherwise. Software for both implementations is included in version 2 of the NASA time and frequency domain analysis program PLATSIM.
Author
Algorithms; Spacecraft Design; Upper Atmosphere Research Satellite (Uars); Vibration; Computation; Memory (Computers)

20040110311 NASA Langley Research Center, Hampton, VA, USA
Experimental Investigation of a Graphite-Composite Intertank Section for a Reusable Launch Vehicle
Sawyer, James Wayne; Bush, Harold; [1997]; 13 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The use of graphite-composites as primary structure is essential for the development of a cost effective single-stage-to-orbit reusable launch vehicle (RLV). A full-scale segment of a graphite-composite intertank was designed and fabricated by an industry team and tested at NASA Langley Research Center as a part of the RLV technology development program. The intertank test component was approximately 3.0 m long by 6.7 m wide and included slightly less than a 90deg section of a cylindrical intertank. The test article was fabricated using graphite-bismaelimide composite material and consisted of a hat-stiffened skin with five ring frames. The stiffeners were secondarily bonded to the panel skin and the ring frames were mechanically attached. The test article was loaded to failure with a uniform compression load applied by 21 individually controlled hydraulic actuators. Resistance strain gages, linear variable differential transformers and video cameras were used to measure and record the test results. A linear f d t e element analysis of the test article and test fixture was performed. The test results verified the structural integrity cf the intertank test article up to the design limit load. However, the test article failed in general skin buckling between the ring frames at a load 1.08 times design limit load. This load was considerably lower than the expected failure load. The cause of premature failure is being investigated. Good correlation of the test and analysis results was obtained for loads up to the design limit load.
Author
Reusable Launch Vehicles; Composite Materials; Graphite; Structural Failure

20040110435 NASA Langley Research Center, Hampton, VA, USA
Integrated Controls-Structures Design Methodology: Redesign of an Evolutionary Test Structure
Maghami, Peiman G.; Gupta, Sandeep; Elliot, Kenny B.; Joshi, Suresh M.; [1997]; 34 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

An optimization-based integrated controls-structures design methodology for a class of flexible space structures is described, and the phase-0 Controls-Structures-Integration evolutionary model, a laboratory testbed at NASA Langley, is redesigned using this integrated design methodology. The integrated controls-structures design is posed as a nonlinear programming problem to minimize the control effort required to maintain a specified line-of-sight pointing performance, under persistent white noise disturbance. Static and dynamic dissipative control strategies are employed for feedback control, and parameters of these controllers are considered as the control design variables. Sizes of strut elements in various sections of the CEM are used as the structural design variables. Design guides for the struts are developed and employed in the integrated design process, to ensure that the redesigned structure can be effectively fabricated. The superiority of the integrated design methodology over the conventional design approach is demonstrated analytically by observing a significant reduction in the average control power needed to maintain specified pointing performance with the integrated design approach.
Author
Controllers; Flexible Spacecraft; Large Space Structures; Phase Control; Structural Design

20040110437 NASA Langley Research Center, Hampton, VA, USA
Experimental Validation of an Integrated Controls-Structures Design Methodology
Maghami, Peiman G.; Gupta, Sandeep; Elliot, Kenny B.; Walz, Joseph E.; [1996]; 35 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The first experimental validation of an integrated controls-structures design methodology for a class of large order, flexible space structures is described. Integrated redesign of the controls-structures-interaction evolutionary model, a laboratory testbed at NASA Langley, was described earlier. The redesigned structure was fabricated, assembled in the laboratory, and experimentally tested against the original structure. Experimental results indicate that the structure redesigned using the integrated design methodology requires significantly less average control power than the nominal structure with control-optimized designs, while maintaining the required line-of-sight pointing performance. Thus, the superiority of the integrated design methodology over the conventional design approach is experimentally demonstrated. Furthermore, amenability of the integrated design structure to other control strategies is evaluated, both analytically and experimentally. Using Linear-Quadratic-Guassian optimal dissipative controllers, it is observed that the redesigned structure leads to significantly improved performance with alternate controllers as well.
Author
Experimentation; Data Acquisition; Integrated Circuits; Controllers; Design Optimization

20040110822 NASA Langley Research Center, Hampton, VA, USA
Aerothermodynamic Analysis of Commercial Experiment Transporter (COMET) Reentry Capsule
Wood, William A.; Gnoffo, Peter A.; Rault, Didier F. G.; [1996]; 9 pp.; In English; 34th Aerospace Sciences Meeting and Exhibit, 15-18 Jan. 1996, Reno, NV, USA
Report No.(s): AIAA Paper 96-0316; Copyright; Avail: CASI; A02, Hardcopy

An aerothermodynamic analysis of the Commercial Experiment Transporter (COMET) reentry capsule has been performed using the laminar thin-layer Navier-Stokes solver Langley Aerothermodynamic Upwind Relaxation Algorithm. Flowfield solutions were obtained at Mach numbers 1.5, 2, 5, 10, 15, 20, 25, and 27.5. Axisymmetric and 5, 10, and 20 degree angles of attack were considered across the Mach-number range, with the Mach 25 conditions taken to 90 degrees angle of attack and the Mach 27.5 cases taken to 60 degrees angle of attack. Detailed surface heat-transfer rates were computed at Mach 20 and 25, revealing that heating rates on the heat-shield shoulder ,can exceed the stagnation-point heating by 230 percent. Finite-rate chemistry solutions were performed above Mach 10, otherwise perfect gas computations were made. Drag, lift, and pitching moment coefficients are computed and details of a wake flow are presented. The effect of including the wake in the solution domain was investigated and base pressure corrections to forebody drag coefficients were numerically determined for the lower Mach numbers. Pitching moment comparisons are made with direct simulation Monte Carlo results in the more rarefied flow at the highest Mach numbers, showing agreement within two-percent. Thin-layer Navier-Stokes computations of the axial force are found to be 15 percent higher across the speed range than the empirical/Newtonian based results used during the initial trajectory analyses.
Author
Aerothermodynamics; Transporter; Space Capsules; Reentry Vehicles; Spacecraft Configurations

20040110941 NASA Langley Research Center, Hampton, VA, USA
Orbiter Aerodynamic Acceleration Flight Measurements in the Rarefied-Flow Transition Regime
Blanchard, Robert C.; Wilmoth, Richard G.; LeBeau, Gerald J.; [1996]; 12 pp.; In English
Report No.(s): AIAA Paper96-2467; Copyright; Avail: CASI; A03, Hardcopy

Acceleration data taken from the Orbital Acceleration Research Experiment (OARE) during reentry on STS-62 have been analyzed using calibration factors taken on orbit. This is the first Orbiter mission which collected OARE data during the Orbiter reentry phase. The data examined include the flight regime from orbital altitudes down to about 90 km which covers the free-molecule-flow regime and the upper altitude fringes of the rarefied-flow transition into the hypersonic continuum. Ancillary flight data on Orbiter position, orientation, velocity, and rotation rates have been used in models to transform the measured accelerations to the Orbiter center-of-gravity, from which aerodynamic accelerations along the Orbiter body axes have been calculated. Residual offsets introduced in the measurements by unmodeled Orbiter forces are identified and discussed. Direct comparisons are made between the OARE flight data and an independent micro-gravity accelerometer experiment, the High Resolution Accelerometer Package (HiRAP), which also obtained flight data on reentry during the mission down to about 95 km. The resulting OARE aerodynamic acceleration measurements along the Orbiter's body axis, aid the normal to axial acceleration ratio in the free-molecule-flow and transition-flow regimes are presented and compared with numerical simulations from three direct simulation Monte Carlo codes.
Author
Rarefied Gas Dynamics; Space Transportation System; Acceleration Measurement; Aerodynamic Coefficients; In-Flight Monitoring; Space Shuttle Orbiters; Transition Flow; Uncontrolled Reentry (Spacecraft)

20040110954 NASA Langley Research Center, Hampton, VA, USA
Analysis of Shuttle Orbiter Reliability and Maintainability Data for Conceptual Studies
Morris, W. D.; White, N. H.; Ebeling, C. E.; [1996]; 11 pp.; In English; 1996 AIAA Space Programs and Technologies Conference, 24-26 Sep. 1996, Huntsville, AL, USA
Report No.(s): AIAA Paper 96-4245; Copyright; Avail: CASI; A03, Hardcopy

In order to provide a basis for estimating the expected support required of new systems during their conceptual design phase, Langley Research Center has recently collected Shuttle Orbiter reliability and maintainability data from the various data base sources at Kennedy Space Center. This information was analyzed to provide benchmarks, trends, and distributions to aid in the analysis of new designs. This paper presents a summation of those results and an initial interpretation of the findings.
Author
Reliability; Space Shuttle Orbiters; Maintainability

20040110975 Johns Hopkins Univ., Columbia, MD, USA
Composite Rocket Motor Case Technology for Tactical Missiles
Fisher, M. J.; Moore, T. L.; Hoffman, H. J.; Drewry, D. G., Jr.; August 2004; 99 pp.; In English
Contract(s)/Grant(s): SPO700-97-D-4004
Report No.(s): CPIA-CPTR-77; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200

U.S. and international efforts between 1979 and 2004 to develop, demonstrate, and implement composite (reinforced plastic) rocket motor cases in tactical missile programs, with an emphasis on the use of the latest generation high strength graphite (carbon) fiber, are reviewed and summarized. The favorable response of composite cases to insensitive munitions stimuli, as well as structural efficiency, has generated increased interest for the insertion of this technology into new, tactical-class propulsion systems. Some discussion on the development and operational history of launch vehicle boosters using composite cases is also included for the purpose of establishing the technology base for tactical systems. Many historically plaguing issues and technical challenges in the use of composite cases for tactical missiles have been successfully addressed in technology programs conducted in both the USA and abroad over the past 25 years. These issues include as-processed materials variability, aging, fatigue, aeroheating, corrosion, moisture intrusion, and structural performance. A broad range of design techniques and materials has been developed to provide for technical robustness and alternative approaches. However, some issues remain for the use of composite-cased rocket motors in the externally-carried, air-launched environment. These issues include volume limitations, case damage tolerance and detection, and cost, maturity and qualification of the materials system for aircraft underwing carriage.
Author
Reinforced Plastics; Rocket Engine Cases; Technology Assessment; Propulsion System Configurations

19
SPACECRAFT INSTRUMENTATION AND ASTRIONICS

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

20040105575 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Geoscience Laser Altimeter System (GLAS) Loop Heat Pipes: An Eventual First Year On-Orbit
Grob, E.; Baker, C.; McCarthy, T.; July 2004; 12 pp.; In English; 34th International Conferrence on Environmental Systems, 18-22 Jul. 2004, Colorado Springs, CO, USA
Report No.(s): Rept-2004-01-2558; No Copyright; Avail: CASI; A03, Hardcopy

Goddard Space Flight Center's Geoscience Laser Altimeter System (GLAS) is the sole scientific instrument on the Ice, Cloud and land Elevation Satellite (ICESat) that was launched on January 12, 2003 from Vandenberg AFB. A thermal control architecture based on propylene Loop Heat Pipe technology was developed to provide selectable/stable temperature control for the lasers and other electronics over the widely varying mission environment. Following a nominal LHP and instrument start-up, the mission was interrupted with the failure of the first laser after only 36 days of operation. During the 5-month failure investigation, the two GLAS LHPs and the electronics operated nominally, using heaters as a substitute for the laser heat load. Just prior to resuming the mission, following a seasonal spacecraft yaw maneuver, one of the LHPs deprimed and created a thermal runaway condition that resulted in an emergency shutdown of the GLAS instrument. This paper presents details of the LHP anomaly, the resulting investigation and recovery, along with on-orbit flight data during these critical events.
Author
Geophysics; Heat Pipes; Ice, Cloud and Land Elevation Satellite; Laser Altimeters; Telemetry; Space Missions; Anomalies

20040105597 NASA Langley Research Center, Hampton, VA, USA
Enhanced Attitude Control Experiment for SSTI Lewis Spacecraft
Maghami, Peoman G.; [1997]; 11 pp.; In English
Report No.(s): AIAA Paper 97-3527; Copyright; Avail: CASI; A03, Hardcopy

The enhanced attitude control system experiment is a technology demonstration experiment on the NASA's small spacecraft technology initiative program's Lewis spacecraft to evaluate advanced attitude control strategies. The purpose of the enhanced attitude control system experiment is to evaluate the feasibility of designing and implementing robust multi-input/multi-output attitude control strategies for enhanced pointing performance of spacecraft to improve the quality of the measurements of the science instruments. Different control design strategies based on modern and robust control theories are being considered for the enhanced attitude control system experiment. This paper describes the experiment as well as the design and synthesis of a mixed H(sub 2)/H(sub infinity) controller for attitude control. The control synthesis uses a nonlinear programming technique to tune the controller parameters and impose robustness and performance constraints. Simulations are

carried out to demonstrate the feasibility of the proposed attitude control design strategy. Introduction
Author
Attitude Control; Control Theory; Simulation; Small Satellite Technology

20040110315 NASA Langley Research Center, Hampton, VA, USA
Efficient Jitter Analysis for Spacecraft
Maghami, Peiman G.; [1998]; 14 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Typically in space missions, the science instruments require a specific degree of pointing accuracy as well as dynamical quietness. This dynamical quietness, which is needed to allow the instruments to make measurements (remote sensing applications) or perform other functions, is usually characterized in terms of jitter and stability specifications. In order to insure that the spacecraft meets the requirements of its instruments, several jitter analyses are performed throughout the design phase of the spacecraft and beyond as the models of the spacecraft, its components, and disturbances mature. Each such analysis involves the simulation of the spacecraft and instrument dynamical response to all known disturbance scenarios, followed by the computation of jitter values for each instrument based on the specified jitter time windows. The direct approach for computing jitter values by sweeping maxima and minima throughout the time history may be costly in the computational sense as the size and number of the time histories involved could be quite large. Keeping in mind that typical spacecraft simulation time histories may easily involve hundreds of thousands or millions of points, it is imperative that a jitter analysis algorithm be developed which is more efficient than the direct approach. This paper presents a vectorized algorithm for efficient computation of spacecraft jitter values. The algorithm identifies the extreme points in the time history, which are the points that may dominate the jitter values depending on the location of the jitter window along the time history. The span of influence of each extremum is then computed by the algorithm and used in an efficient and vectorized fashion to obtain the jitter values. The algorithm deals with the multiple jitter windows 2 sequentially, first computing jitter values for the smallest time window, then looping over the remaining time windows until all jitter values are computed. A numerical example is carried out to demonstrate the efficiency and feasibility of the proposed jitter analysis technique.
Author
Efficiency; Algorithms; Dynamic Response; Remote Sensing

20040110656 NASA Langley Research Center, Hampton, VA, USA
A Robust Control Design Framework for Substructure Models
Lim, Kyong B.; [1994]; 13 pp.; In English
Report No.(s): AIAA Paper 94-1699; No Copyright; Avail: CASI; A03, Hardcopy

A framework for designing control systems directly from substructure models and uncertainties is proposed. The technique is based on combining a set of substructure robust control problems by an interface stiffness matrix which appears as a constant gain feedback. Variations of uncertainties in the interface stiffness are treated as a parametric uncertainty. It is shown that multivariable robust control can be applied to generate centralized or decentralized controllers that guarantee performance with respect to uncertainties in the interface stiffness, reduced component modes and external disturbances. The technique is particularly suited for large, complex, and weakly coupled flexible structures.
Author
Multivariable Control; Design Analysis; Feedback

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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*.

20040105532 NASA Langley Research Center, Hampton, VA, USA
Future Directions of Supersonic Combustion Research: Air Force/NASA Workshop on Supersonic Combustion
Tishkoff, Julian M.; Drummond, J. Philip; Edwards, Tim; Nejad, Abdollah S.; [1996]; 40 pp.; In English; Air Force/NASA Workshop on Supersonic Combustion, 14-16 May 1996, USA; Copyright; Avail: CASI; A03, Hardcopy

The Air Force Office of Scientific Research, the Air Force Wright Laboratory Aero Propulsion and Power Directorate, and the NASA Langley Research Center held a joint supersonic combustion workshop on 14-16 May 1996. The intent of this meeting was to: (1) examine the current state-of-the-art in hydrocarbon and/or hydrogen fueled scramjet research; (2) define

the future direction and needs of basic research in support of scramjet technology; and (3) when appropriate, help transition basic research findings to solve the needs of developmental engineering programs in the area of supersonic combustion and fuels. A series of topical sessions were planned. Opening presentations were designed to focus and encourage group discussion and scientific exchange. The last half-day of the workshop was set aside for group discussion of the issues that were raised during the meeting for defining future research opportunities and directions. The following text attempts to summarize the discussions that took place at the workshop.
Author
Supersonic Combustion Ramjet Engines; Hydrocarbons; Fuel Combustion

20040110362 NASA Langley Research Center, Hampton, VA, USA
Development of Temperature Sensitive Paints for the Detection of Small Temperature Differences
Oglesby, Donald M.; Upchurch, Billy T.; Sealey, Bradley S.; Leighty, Bradley D.; Burkett, Cecil G., Jr.; Jalali, Amir; [1997]; 9 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Temperature sensitive paints (TSP s) have recently been used to detect small temperature differences on aerodynamic model surfaces. These types of applications impose stringent performance requirements on a paint system. The TSP s must operate over a broad temperature range, must be physically robust (cannot chip or peel), must be polishable to at least the smoothness of the model surface, and must have sufficient sensitivity to detect small temperature differences. TSP coatings based on the use of metal complexes in polymer binders were developed at NASA Langley Research Center which meet most of the requirements for detection of small temperature differences under severe environmental conditions.
Author
Complex Compounds; Temperature Gradients; Temperature Sensitive Paints

20040110468 Office National d'Etudes et de Recherches Aerospatiales, Paris
Combustion of Solid Propellants
Lengelle, G.; Duterque, J.; Trubert, J. F.; May 2002; 63 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425264; No Copyright; Avail: CASI; A04, Hardcopy

A review of the understanding of the combustion mechanisms of solid propellants that the authors have built from their work and from the literature is presented. Such an understanding is an important part of the process carried out to master the behavior of solid propellants and to obtain desired characteristics (with respect to energetic level, burning rate level, sensitivity to pressure and initial temperature, nature of emitted combustion products, vulnerability to various aggressions...). The propellants and propellant components considered are: double-base propellants, based on nitrocellulose and nitroglycerin, ' active binder, based on an inert polymer (or energetic such as PAG) and a liquid nitrate ester, inert binders, such as polybutadiene, ammonium perchlorate, nitramines, such as HMX, RDX and CL20 (HNIW), composite ammonium perchlorate-inert binder propellants, composite propellants based on a nitramine and an active binder, aluminum, with respect to the two previous types of propellants, additives, when appropriate. The features of the combustion zone described are: In the condensed phase, the thickness of the temperature profile and of the decomposition zone, the kinetics of the decomposition, the energy released, the nature of the gases evolved, the surface temperature; In the gas phase, the type of flame structure (diffusion or kinetically controlled), the possibility of staging (such as in double-base propellants), the kinetics of the reaction(s), the energy released, the flame temperature (primary and final, when applicable).
DTIC
Solid Propellant Combustion; Solid Propellants

20040110828 NASA Glenn Research Center, Cleveland, OH, USA
Computational Ion Optics Design Evaluations
Malone, Shane P.; Soulas, George C.; August 2004; 22 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): WBS 22-319-20-B2
Report No.(s): NASA/TM-2004-213206; AIAA Paper 2004-3784; E-14714; No Copyright; Avail: CASI; A03, Hardcopy

Ion optics computational models are invaluable tools in the design of ion optics systems. In this study a new computational model developed by an outside vendor for use at the NASA Glenn Research Center (GRC) is presented. This computational model is a gun code that has been modified to model the plasma sheaths both upstream and downstream of the ion optics. The model handles multiple species (e.g. singly and doubly-charged ions) and includes a charge-exchange model to support erosion estimations. The model uses commercially developed solid design and meshing software to allow high

flexibility in ion optics geometric configurations. The results from this computational model are applied to the NEXT project to investigate the effects of crossover impingement erosion seen during the 2000-hour wear test.
Author
Ion Optics; Plasma Sheaths; Charge Transfer; Wear Tests

20040110836 QSS Group, Inc., Cleveland, OH, USA
On the Operational Status of the ISS Plasma Contactor Hollow Cathodes
Burke, Thomas P., Technical Monitor; Carpenter, Christian B.; August 2004; 18 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS3-00145; WBS 22-982-10-02
Report No.(s): NASA/CR-2004-213184; AIAA Paper 2004-3425; E-14680; No Copyright; Avail: CASI; A03, Hardcopy

The Plasma Contactor Unit (PCU) was developed by the Rocketdyne division of The Boeing Company to control charging of the International Space Station (ISS). Each PCU contains a Hollow Cathode Assembly (HCA), which emits the charge control electrons. The HCAs were designed and fabricated at NASA s Glenn Research Center (GRC). GRC's HCA development program included manufacture of engineering, qualification, and flight model HCAs as well as qualification and wear tests. GRC tracks the on-orbit data for the flight HCAs in order to ascertain their overall health. As of April 5, 2004, 43 ignitions and over 6000 hours have been accumulated on a single unit. The flight HCAs continue to operate flawlessly. This paper will discuss the operation of the HCAs during ground tests and on-orbit operation from initial startup to April 30, 2004.
Author
Contactors; Fabrication; Hollow Cathodes; International Space Station; Plasmas (Physics); Ion Engines; Flight Operations

20040110837 NASA Glenn Research Center, Cleveland, OH, USA
Ion Engine Grid Gap Measurements
Soulas, Gerge C.; Frandina, Michael M.; August 2004; 21 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): WBS 22-755-70-04
Report No.(s): NASA/TM-2004-213215; AIAA Paper 2004-3961; E-14723; No Copyright; Avail: CASI; A03, Hardcopy

A simple technique for measuring the grid gap of an ion engine s ion optics during startup and steady-state operation was demonstrated with beam extraction. The grid gap at the center of the ion optics assembly was measured with a long distance microscope that was focused onto an alumina pin that protruded through the center accelerator grid aperture and was mechanically attached to the screen grid. This measurement technique was successfully applied to a 30 cm titanium ion optics assembly mounted onto an NSTAR engineering model ion engine. The grid gap and each grid s movement during startup from room temperature to both full and low power were measured. The grid gaps with and without beam extraction were found to be significantly different. The grid gaps at the ion optics center were both significantly smaller than the cold grid gap and different at the two power levels examined. To avoid issues associated with a small grid gap during thruster startup with titanium ion optics, a simple method was to operate the thruster initially without beam extraction to heat the ion optics. Another possible method is to apply high voltage to the grids prior to igniting the discharge because power deposition to the grids from the plasma is lower with beam extraction than without. Further testing would be required to confirm this approach.
Author
Ion Engines; Ion Propulsion; Ion Optics; Plasmas (Physics); Steady State

20040110839 Michigan Univ., Ann Arbor, MI, USA
Progress in NEXT Ion Optics Modeling
Emhoff, Jerold W.; Boyd, Iain D.; August 2004; 15 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAG3-2497; WBS 22-800-50-01
Report No.(s): NASA/CR-2004-213224; AIAA Paper 2004-3786; E-14731; No Copyright; Avail: CASI; A03, Hardcopy

Results are presented from an ion optics simulation code applied to the NEXT ion thruster geometry. The error in the potential field solver of the code is characterized, and methods and requirements for reducing this error are given. Results from a study on electron backstreaming using the improved field solver are given and shown to compare much better to experimental results than previous studies. Results are also presented on a study of the beamlet behavior in the outer radial apertures of the NEXT thruster. The low beamlet currents in this region allow over-focusing of the beam, causing direct impingement of ions on the accelerator grid aperture wall. Different possibilities for reducing this direct impingement are

analyzed, with the conclusion that, of the methods studied, decreasing the screen grid aperture diameter eliminates direct impingement most effectively.
Author
Ion Optics; Xenon; Propulsion System Configurations; Propulsion System Performance

20040110840 QSS Group, Inc., Cleveland, OH, USA
Evaluation of Pulsed Plasma Thruster Micropulsing
Arrington, Lynn; August 2004; 16 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS3-00145; WBS 22-319-20-02
Report No.(s): NASA/CR-2004-213209; AIAA Paper 2004-3458; E-14717; No Copyright; Avail: CASI; A03, Hardcopy

This paper evaluates the concept of pulsed plasma thruster (PPT) micropulsing. Micropulsing was a premise behind a power processing unit (PPU) and an energy storage unit (ESU) design that for certain mission profiles, it was advantageous to operate a PPT at lower energy but higher frequency rather than at a higher energy but lower frequency. This premise allows for reductions in the ESU volume and mass without paying a penalty in thrust. To complete the evaluation, an independent spark plug initiation unit, a high voltage power supply and a variety of mica foil capacitors at 2.6, 5, 10, and 20 capacitance were used to conduct a series of tests on a single PPT to map performance levels of thrust, impulse bit, efficiency and specific impulse over a comparable power range. Testing at NASA Glenn Research Center was conducted with breadboard PPT hardware. The test results showed that operating in the lower energy ESU micropulsing mode produced similar thrust levels to a higher energy ESU operating at high power level. Further testing however showed a reduction in specific impulse and efficiency when the smaller capacitances were used at the highest power levels. This would require more fuel mass for a mission that was predominately high power, potentially negating the ESU mass savings. Therefore, micropulsing is advantageous where most of a mission profile occurs at low power, but retains the ability to conduct high thrust maneuvers when necessary.
Author
Pulsed Plasma Thrusters; Capacitance; Fabrication; Frequency Control; Electric Pulses; Energy Storage

23
CHEMISTRY AND MATERIALS (GENERAL)

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

20040110648 Lawrence Livermore National Lab., Livermore, CA
Aggregation Quenching in Thin Films of MEH-PPV Studied by Near-Field Scanning Optical Microscopy and Spectroscopy
Huser, T.; Yan, M.; Apr. 11, 2000; 16 pp.; In English
Report No.(s): DE2004-15007527; UCRL-JC-138638; No Copyright; Avail: Department of Energy Information Bridge

Aggregates in thin films of conjugated polymers form excimer states and significantly reduce the photo- and electroluminescence efficiency in devices produced from these materials. We have studied the aggregate formation in thin films of MEH-PPV by near-field scanning optical microscopy and spectroscopy. Local photoluminescence spectroscopy and photo-bleaching experiments have been used to show that thin films of MEH-PPV are homogeneously aggregated and do not form aggregated domains.
NTIS
Aggregates; Thin Films; Polymers; Optical Scanners; Electroluminescence

20040110651 Lawrence Livermore National Lab., Livermore, CA
Making Nanostructured Pyrotechnics in a Beaker
Gash, A. E.; Simpson, R. L.; Tillotson, T. M.; Satcher, J. H.; Hrubesh, L. W.; Apr. 10, 2000; 22 pp.; In English
Report No.(s): DE2004-15007525; UCRL-JC-137593; No Copyright; Avail: Department of Energy Information Bridge

Controlling composition at the nanometer scale is well known to alter material properties in sometimes highly desirable and dramatic ways. In the field of energetic materials component distributions, particle size, and morphology, effect both sensitivity and reactivity performance. To date nanostructured energetic materials are largely unknowns with the exception of

nanometer-sized reactive powders now being produced at a number of laboratories. We have invented a new method of making nanostructured energetic materials, specifically explosives, propellants, and pyrotechnics, using sol-gel chemistry. The ease of this synthetic approach along with the inexpensive, stable, and benign nature of the metal precursors and solvents permit large-scale syntheses to be carried out. This approach can be accomplished using low cost processing methods. We will describe here, for the first time, this new synthetic route for producing metal-oxide-based pyrotechnics. The procedure employs the use of stable and inexpensive hydrated-metal inorganic salts and environmentally friendly solvents such as water and ethanol. The synthesis is straightforward and involves the dissolution the metal salt in a solvent followed by the addition of an epoxide, which induces gel formation in a timely manner. Experimental evidence suggests that the epoxide acts as an irreversible proton scavenger that induces the hydrated-metal species to undergo hydrolysis and condensation to form a sol that undergoes. further condensation to form a metal-oxide nanostructured gel. Both critical point and atmospheric drying have been employed to produce monolithic aerogels and xerogels, respectively.
NTIS
Aerogels; Epoxy Compounds; Pyrotechnics; Metal Oxides

20040110659 NASA Langley Research Center, Hampton, VA, USA
Polarization and Piezoelectric Properties of a Nitrile Substituted Polyimide
Simpson, Joycelyn; Ounaies, Zoubeida; Fay, Catharine; [1997]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

This research focuses on the synthesis and characterization of a piezoelectric (beta-CN)- APB/ODPA polyimide. The remanent polarization and piezoelectric d(sub 31) and g(sub 33) coefficients are reported to assess the effect of synthesis variations. Each of the materials exhibits a level of piezoelectricity which increases with temperature. The remanent polarization is retained at temperatures close to the glass transition temperature of the polyimide.
Author
Polyimides; Synthesis (Chemistry); Piezoelectricity

20040110673 Westinghouse Savannah River Co., Aiken, SC, USA
Assessment of Aging of Cork and TISAF Materials in the SAFKEG 3940A Package in KAMS (U)
Vormelker, P. R.; Duncan, A. J.; Jun. 2003; In English
Report No.(s): DE2004-820088; WSRC-TR-2003-00197; No Copyright; Avail: National Technical Information Service (NTIS)

This report provides an assessment of the potential for aging and degradation of the resin-bonded cork and the Thermal-Insulating, Shock-Absorbing Foam materials that are components of the SAFKEG 3940A package. This package may be used for interim storage of plutonium materials in the Savannah River Site K-Area Materials Storage.
NTIS
Thermal Insulation; Foams; Aging (Materials)

20040110674 Lawrence Livermore National Lab., Livermore, CA
Development of Wet-Etching Tools for Precision Optical Figuring
Rushford, M. C.; Dixit, S. N.; Hyde, R.; Britten, J. A.; Nissen, J.; Jan. 27, 2004; In English
Report No.(s): DE2004-15007304; UCRL-TR-155880; No Copyright; Avail: National Technical Information Service (NTIS)

This FY03 final report on Wet Etch Figuring involves a 2D thermal tool. Its purpose is to flatten (0.3 to 1 mm thickness) sheets of glass faster thus cheaper than conventional sub aperture tools. An array of resistors on a circuit board was used to heat acid over the glass Optical Path Difference (OPD) thick spots and at times this heating extended over the most of the glass aperture. Where the acid is heated on the glass it dissolves faster. A self-referencing interferometer measured the glass thickness, its design taking advantage of the parallel nature and thinness of these glass sheets. This measurement is used in close loop control of the heating patterns of the circuit board thus glass and acid. Only the glass and acid were to be moved to make the tool logistically simple to use in mass production. A set of 4-circuit board, covering 80 x 80-cm aperture was ordered, but only one 40 x 40-cm board was put together and tested for this report. The interferometer measurement of glass OPD was slower than needed on some glass profiles. Sometimes the interference fringes were too fine to resolve which would alias the sign of the glass thickness profile. This also caused the phase unwrapping code (FLYNN) to struggle thus run slowly at times taking hours, for a 10 inch square area. We did extensive work to improve the speed of this code. We tried many different phase unwrapping codes. Eventually running (FLYNN) on a farm of networked computers. Most of the work reported here is therefore limited to a 10-inch square aperture. Researched into fabricating a better interferometer lens from Plexiglas so to have less of the scattered light issues of Fresnel lens groves near field scattering patterns, this set the Nyquest limit. There

was also a problem with the initial concept of wetting the 1737 glass on its bottom side with acid. The wetted 1737 glass developed an Achromatic AR coating, spoiling the reflection needed to see glass thickness interference fringes. In response to this dilemma, the acid wetting was moved to the top of the glass and the thermal diffusion layer under the glass replaced with rubber. The bottom side of the glass was then protected from etching with a vacuum grease layer on the glass, though many other ways were tried and need to be further developed. We switched our mission away from flattening the OPD of 1737 glass, as the Eyeglass project no longer wanted glass. We turned our attention to the NIF Borofloat Debris shields.
NTIS
Fabrication; Interferometers; Wetting; Etching; Optical Paths

20040110829 NASA Glenn Research Center, Cleveland, OH, USA
Ultra High Voltage Propellant Isolators and Insulators for JIMO Ion Thrusters
Banks, Bruce A.; Gaier, James R.; Hung, Ching-Cheh; Walters, Patty A.; Sechkar, Ed; Panko, Scott; Kamiotis, Christina A.; July 2004; 18 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NCC3-1023; WBS 22-319-20-E1
Report No.(s): NASA/TM-2004-213181; AIAA Paper 2004-3815; E-14676; No Copyright; Avail: CASI; A03, Hardcopy

Within NASA's Project Prometheus, high specific impulse ion thrusters for electric propulsion of spacecraft for the proposed Jupiter Icy Moon Orbiter (JIMO) mission to three of Jupiter's moons: Callisto, Ganymede and Europa will require high voltage operation to meet mission propulsion. The anticipated approx.6,500 volt net ion energy will require electrical insulation and propellant isolation which must exceed that used successfully by the NASA Solar Electric Propulsion Technology Readiness (NSTAR) Deep Space 1 mission thruster by a factor of approx.6. Xenon propellant isolator prototypes that operate at near one atmosphere and prototypes that operate at low pressures (\h100 Torr) have been designed and are being tested for suitability to the JIMO mission requirements. Propellant isolators must be durable to Paschen breakdown, sputter contamination, high temperature, and high voltage while operating for factors longer duration than for the Deep Space 1 Mission. Insulators used to mount the thrusters as well as those needed to support the ion optics have also been designed and are under evaluation. Isolator and insulator concepts, design issues, design guidelines, fabrication considerations and performance issues are presented. The objective of the investigation was to identify candidate isolators and insulators that are sufficiently robust to perform durably and reliably during the proposed JIMO mission.
Author
Deep Space 1 Mission; Electric Propulsion; High Temperature; Solar Electric Propulsion; Mission Planning

20040111004 Defence Science and Technology Organisation, Fishermans Bend, Australia
Pipe Cleaning using 3M HFE Solvents and the RAAF Oxygen System Pipe Cleaning System
Fletcher, Lyn E.; Zugno, Robert; Dimas, Jim; February 2004; 55 pp.; In English
Report No.(s): DSTO-TR-1563; DODA-AR-013-052; Copyright; Avail: Other Sources

This report details the stages in the development of a novel oxygen system pipe cleaning system, and associated cleaning procedures, for use at RAAF oxygen maintenance workshops. This cleaning system uses 3M HFE solvents and pressure vessels for solvent delivery. Detailed test results and procedures are included. These tests covered RAAF oxygen system pipes in various diameters ranging from l/8 in. to 1/2 in. in stainless steel, copper and aluminium, and various pipe connectors. The tests showed that the final system developed is able to meet the RAN cleanliness specification for oxygen systems for both non-volatile residue and particulate contamination.
Author
Cleaning; Pipes (Tubes); Solvents; Oxygen Supply Equipment

24
COMPOSITE MATERIALS

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

20040095929 Army Research Lab., Hampton, VA, USA
Superelement Analysis of Tile-Reinforced Composite Armor
Davila, Carlos G.; [1998]; 14 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Super-elements can greatly improve the computational efficiency of analyses of tile-reinforced structures such as the hull of the Composite Armored Vehicle. By taking advantage of the periodicity in this type of construction, super-elements can be used to simplify the task of modeling, to virtually eliminate the time required to assemble the stiffness matrices, and to reduce

significantly the analysis solution time. Furthermore, super-elements are fully transferable between analyses and analysts, so that they provide a consistent method to share information and reduce duplication. This paper describes a methodology that was developed to model and analyze large upper hull components of the Composite Armored Vehicle. The analyses are based on two types of superelement models. The first type is based on element-layering, which consists of modeling a laminate by using several layers of shell elements constrained together with compatibility equations. Element layering is used to ensure the proper transverse shear deformation in the laminate rubber layer. The second type of model uses three-dimensional elements. Since no graphical pre-processor currently supports super-elements, a special technique based on master-elements was developed. Master-elements are representations of super-elements that are used in conjunction with a custom translator to write the superelement connectivities as input decks for ABAQUS.
Author
Armor; Composite Materials; Deformation; Hulls (Structures); Shear Stress

20040095947 Army Research Lab., Hampton, VA, USA
Analysis of Tile-Reinforced Composite Armor, Part 1, Advanced Modeling and Strength Analyses
Davila, C. G.; Chen, Tzi-Kang; Baker, D. J.; [1998]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The results of an analytical and experimental study of the structural response and strength of tile-reinforced components of the Composite Armored Vehicle are presented. The analyses are based on specialized finite element techniques that properly account for the effects of the interaction between the armor tiles, the surrounding elastomers, and the glass-epoxy sublaminates. To validate the analytical predictions, tests were conducted with panels subjected to three-point bending loads. The sequence of progressive failure events for the laminates is described. This paper describes the results of Part 1 of a study of the response and strength of tile-reinforced composite armor.
Author
Composite Structures; Tiles; Military Vehicles; Reinforcing Materials; Structural Analysis; Armor; Mechanical Properties

20040100698 NASA Langley Research Center, Hampton, VA, USA
A Damage-Dependent Finite Element Analysis for Fiber-Reinforced Composite Laminates
Coats, Timothy W.; Harris, Charles E.; [1998]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A progressive damage methodology has been developed to predict damage growth and residual strength of fiber-reinforced composite structure with through penetrations such as a slit. The methodology consists of a damage-dependent constitutive relationship based on continuum damage mechanics. Damage is modeled using volume averaged strain-like quantities known as internal state variables and is represented in the equilibrium equations as damage induced force vectors instead of the usual degradation and modification of the global stiffness matrix.
Author
Composite Structures; Damage; Fiber Composites; Finite Element Method; Laminates; Mathematical Models

20040100702 NASA Langley Research Center, Hampton, VA, USA
Lamb Wave Assessment of Fatigue and Thermal Damage in Composites
Seale, Michael D.; Smith, Barry T.; Prosser, W. H.; [2004]; 9 pp.; In English
Contract(s)/Grant(s): NAS1-19656; NAG1-1063; Copyright; Avail: CASI; A02, Hardcopy

Among the various techniques available, ultrasonic Lamb waves offer a convenient method of evaluating composite materials. Since the Lamb wave velocity depends on the elastic properties of a structure, an effective tool exists to monitor damage in composites by measuring the velocity of these waves. Lamb wave measurements can propagate over long distances and are sensitive to the desired in-plane elastic properties of the material. This paper describes two studies which monitor fatigue damage and two studies which monitor thermal damage in composites using Lamb waves. In the fatigue studies, the Lamb wave velocity is compared to modulus measurements obtained using strain gage measurements in the first experiment and the velocity is monitored along with the crack density in the second. In the thermal damage studies, one examines samples which were exposed to varying temperatures for a three minute duration and the second includes rapid thermal damage in composites by intense laser beams. In all studies, the Lamb wave velocity is demonstrated to be an excellent method to monitor damage in composites.
Author
Composite Materials; Fatigue (Materials); Lamb Waves; Ultrasonic Radiation; Laser Damage

20040100723 NASA Langley Research Center, Hampton, VA, USA

Analytical Predictions of Crack Growth Resistance in Notched Composite Panels

Coats, Timothy W.; Harris, Charles E.; [1998]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Fibrous composite materials exhibit R-curve type behavior similar to the fracture behavior of metals. R-curve type behavior in fiber-reinforced composites and in metals is a manifestation of existing toughening mechanisms. Damage tolerance studies have discovered similarities between metals and fiber-reinforced composites as well as some obvious differences. Unlike homogeneous metals, composite materials are made of multiple constituents. Therefore, the modes and types of failure are more complex. While the matrix material in the composite may have similarities to metal in terms of modes of crack opening, composites have fiber fractures and delaminations which affect the redistribution of load. This leads to the conclusion that the toughening mechanisms are different in composites and metals. Toughening mechanisms are physical phenomena responsible for crack growth resistance. Crack-tip plasticity, for example, is a dominant toughening mechanism in metals. The toughening mechanisms in in composites are due to micro-cracking. Even though the toughening mechanisms are fundamentally different for metals and composites, the result for both materials is the elimination of the stress singularity and the effect on load redistribution. Because the notch-tip damage in a composite laminate is not a well defined and quantifiable crack like the notch-tip damage in metals, the terms crack growth and crack growth resistance may not be suitable for composites. The terms damage growth and damage growth resistance will be used when discussing composite laminates. Author

Crack Propagation; Cracks; Fracture Mechanics; Fractures (Materials); Damage; Laminates; Fiber Composites; Loads (Forces)

20040100742 NASA Langley Research Center, Hampton, VA, USA

Ultrasonic Attenuation Results of Thermoplastic Resin Composites Undergoing Thermal and Fatigue Loading

Madaras, Eric I.; [1998]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

As part of an effort to obtain the required information about new composites for aviation use, materials and NDE researchers at NASA are jointly performing mechanical and NDE measurements on new composite materials. The materials testing laboratory at NASA is equipped with environmental chambers mounted on load frames that can expose composite materials to thermal and loading cycles representative of flight protocols. Applying both temperature and load simultaneously will help to highlight temperature and load interactions during the aging of these composite materials. This report highlights our initial ultrasonic attenuation results from thermoplastic composite samples that have undergone over 4000 flight cycles to date. Ultrasonic attenuation measurements are a standard method used to assess the effects of material degradation. Recently, researchers have shown that they could obtain adequate contrast in the evaluation of thermal degradation in thermoplastic composites by using frequencies of ultrasound on the order of 24 MHz. In this study, we address the relationship of attenuation measured at lower frequencies in thermoplastic composites undergoing both thermal and mechanical loading. We also compare these thermoplastic results with some data from thermoset composites undergoing similar protocols. The composite s attenuation is reported as the slope of attenuation with respect to frequency, defined as b = Da(f)/Df. The slope of attenuation is an attractive parameter since it is quantitative, yet does not require interface corrections like conventional quantitative attenuation measurements. This latter feature is a consequence of the assumption that interface correction terms are frequency independent. Uncertainty in those correction terms can compromise the value of conventional quantitative attenuation data. Furthermore, the slope of the attenuation more directly utilizes the bandwidth information and in addition, the bandwidth can be adjusted in the post processing stage to compensate for the loss of dynamic range of the signal as the composites age. Author (revised)

Thermoplastic Resins; Resin Matrix Composites; Thermal Fatigue; Ultrasonic Tests; Nondestructive Tests

20040100755 NASA Langley Research Center, Hampton, VA, USA

Lamb Wave Stiffness Characterization of Composites Undergoing Thermal-Mechanical Aging

Seale, Michael D.; Madaras, Eric I.; [2004]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The introduction of new, advanced composite materials into aviation systems requires a thorough understanding of the long term effects of combined thermal and mechanical loading upon those materials. Analytical methods investigating the effects of intense thermal heating combined with mechanical loading have been investigated. The damage mechanisms and fatigue lives were dependent on test parameters as well as stress levels. Castelli, et al. identified matrix dominated failure modes for out-of-phase cycling and fiber dominated damage modes for in-phase cycling. In recent years, ultrasonic methods have been developed that can measure the mechanical stiffness of composites. To help evaluate the effect of aging, a suitably designed Lamb wave measurement system is being used to obtain bending and out-of-plane stiffness coefficients of composite laminates undergoing thermal-mechanical loading. The system works by exciting an antisymmetric Lamb wave and

calculating the velocity at each frequency from the known transducer separation and the measured time-of-flight. The same peak in the waveforms received at various distances is used to measure the time difference between the signals. The velocity measurements are accurate and repeatable to within 1% resulting in reconstructed stiffness values repeatable to within 4%. Given the material density and plate thickness, the bending and out-of-plane shear stiffnesses are calculated from a reconstruction of the dispersion curve. A mechanical scanner is used to move the sensors over the surface to map the time-of-flight, velocity, or stiffnesses of the entire specimen. Access to only one side of the material is required and no immersion or couplants are required because the sensors are dry coupled to the surface of the plate. In this study, the elastic stiffnesses D(sub 11), D(sub 22), A(sub 44), and A(sub 55) as well as time-of-flight measurements for composite samples that have undergone combined thermal and mechanical aging for a duration of 10,000 hours are reported.
Author (revised)
Graphite-Polyimide Composites; Lamb Waves; Accelerated Life Tests; Stiffness; Laminates

20040100788 NASA Langley Research Center, Hampton, VA, USA
Thermographic Imaging of Defects in Anisotropic Composites
Plotnikov, Y. A.; Winfree, W. P.; [2000]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Composite materials are of increasing interest to the aerospace industry as a result of their weight versus performance characteristics. One of the disadvantages of composites is the high cost of fabrication and post inspection with conventional ultrasonic scanning systems. The high cost of inspection is driven by the need for scanning systems which can follow large curve surfaces. Additionally, either large water tanks or water squirters are required to couple the ultrasonics into the part. Thermographic techniques offer significant advantages over conventional ultrasonics by not requiring physical coupling between the part and sensor. The thermographic system can easily inspect large curved surface without requiring a surface following scanner. However, implementation of Thermal Nondestructive Evaluations (TNDE) for flaw detection in composite materials and structures requires determining its limit. Advanced algorithms have been developed to enable locating and sizing defects in carbon fiber reinforced plastic (CFRP). Thermal Tomography is a very promising method for visualizing the size and location of defects in materials such as CFRP. However, further investigations are required to determine its capabilities for inspection of thick composites. In present work we have studied influence of the anisotropy on the reconstructed image of a defect generated by an inversion technique. The composite material is considered as homogeneous with macro properties: thermal conductivity K, specific heat c, and density rho. The simulation process involves two sequential steps: solving the three dimensional transient heat diffusion equation for a sample with a defect, then estimating the defect location and size from the surface spatial and temporal thermal distributions (inverse problem), calculated from the simulations.
Derived from text
Anisotropy; Composite Materials; Composite Structures; Defects; Imaging Techniques; Thermography

20040105589 NASA Langley Research Center, Hampton, VA, USA
A Review of the NASA Textile Composites Research
Poe, C. C., Jr.; Dexter, H. B.; Raju, I. S.; [1997]; 13 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

During the past 15 years NASA has taken the lead role in exploiting the benefits of textile reinforced composite materials for application to aircraft structures. The NASA Advanced Composites Technology (ACT) program was started in 1989 to develop composite primary structures for commercial transport airplanes with costs that are competitive with metal structures. As part of this program, several contractors investigated the cost, weight, and performance attributes of textile reinforced composites. Textile composites made using resin transfer molding type processes were evaluated for numerous applications. Methods were also developed to predict resin infiltration and flow in textile preforms and to predict and measure mechanical properties of the textile composites. This paper describes the salient results of that program.
Author
Composite Materials; Textiles; Aircraft Structures; NASA Programs; Research and Development; Commercial Aircraft; Mechanical Properties

20040105606 NASA Langley Research Center, Hampton, VA, USA
Experimental Observations of a Stitched Composite with a Notch Subjected to Combined Bending and Tension Loading
Palmer, Susan O.; Nettles, Alan T.; Poe, C. C.; [1998]; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A series of tests was conducted to support development of an analytical model for predicting the failure strains of stitched warp-knit carbon/epoxy composite materials with through-thicknesss damage in the form of a crack-like notch. Measurements

of strain near notch tips, crack opening displacement (COD), and applied load were monitored in all tests. The out-of-plane displacement at the center of the notch was also measured when the specimen was subjected to bending. Three types of loading were applied: pure bending, pure tension, and combined bending and tension.
Author
Bending; Loads (Forces); Notches; Tension; Mathematical Models; Epoxy Matrix Composites

20040105616 NASA Langley Research Center, Hampton, VA, USA
Evaluation of a Progressive Failure Analysis Methodology for Laminated Composite Structures
Sleight, David W.; Knight, Norman F., Jr.; Wang, John T.; [1997]; 17 pp.; In English; AIAA/ASME/ASCE/AHS/ASC 38th Structures, Structural Dynamics and Materials Conference, 7-10 Apr. 1997, USA
Report No.(s): AIAA Paper 97-1187; Copyright; Avail: CASI; A03, Hardcopy

A progressive failure analysis methodology has been developed for predicting the nonlinear response and failure of laminated composite structures. The progressive failure analysis uses C plate and shell elements based on classical lamination theory to calculate the in-plane stresses. Several failure criteria, including the maximum strain criterion, Hashin's criterion, and Christensen's criterion, are used to predict the failure mechanisms. The progressive failure analysis model is implemented into a general purpose finite element code and can predict the damage and response of laminated composite structures from initial loading to final failure.
Author
Composite Structures; Failure Analysis; Laminates; Mathematical Models; Mechanical Properties; Methodology

20040105645 NASA Langley Research Center, Hampton, VA, USA
Hybrid Titanium Composite Laminates: A New Aerospace Material
Johnson, W. S.; Cobb, Ted Q.; Lowther, Sharon; St.Clair, T. L.; [1998]; 3 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

In the realm of aerospace design and performance, there are few boundaries in the never-ending drive for increased performance. This thirst for ever-increased performance of aerospace equipment has driven the aerospace and defense industries into developing exotic, extremely high-performance composites that are pushing the envelope in terms of strength-to-weight ratios, durability, and several other key measurements. To meet this challenge of ever-increasing improvement, engineers and scientists at NASA-Langley Research Center (NASA-LaRC) have developed a high-temperature metal laminate based upon titanium, carbon fibers, and a thermoplastic resin. This composite, known as the Hybrid Titanium Composite Laminate, or HTCL, is the latest chapter in a significant, but relatively short, history of metal laminates.
Author
Carbon Fibers; Hybrid Composites; Laminates; Titanium; Fatigue (Materials); Damage

20040110250 California Univ., Santa Barbara, CA, USA
Biomimetic, Self-Healing Nanocomposites for Aerospace Applications
Morse, Daniel E.; [2003]; 6 pp.; In English
Contract(s)/Grant(s): NAG1-01003; No Copyright; Avail: CASI; A02, Hardcopy

This final report contains a summary of significant findings, and bibliographies of publications and patents resulting from the research. The findings are grouped as follows: A) Lustrin-Mimetic Self-Healing Polymer Networks; B) Nanostructure-Directing Catalysis of Synthesis of Electronically and Optoelectronically Active Metallo-oxanes and Organometallics; C) New Discovery that Molecular Stencils Control Directional Growth to Form Light-Weight Mineral Foams.
Author
Nanocomposites; Biomimetics; Self Repairing Devices

20040110252 NASA Langley Research Center, Hampton, VA, USA
Sensitivity Studies for In-Situ Automated Tape Placement of Thermoplastic Composites
Costen, Robert C.; Marchello, Joseph M.; [2004]; 15 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

This modeling effort seeks to improve the interlaminate bond strength of thermoplastic carbon composites produced by the in-situ automated tape placement (ATP) process. An existing high productivity model is extended to lower values of the Peclet number that correspond to the present operating conditions of the Langley ATP robot. (The Peclet number is the dimensionless ratio of inertial to diffusive heat transfer.) In sensitivity studies, all of the process and material parameters are individually varied. The model yields the corresponding variations in the effective bonding time (EBT) referred to the glass

transition temperature. According to reptation theory, the interlaminate bond strength after wetting occurs is proportional to the one-fourth power of EBT. The model also computes the corresponding variations in the thermal input power (TIP) and the mass and volumetric process rates. Process studies show that a 10 percent increase in the consolidation length results in a 20 percent increase in EBT and a 5 percent increase in TIP. A surprising result is that a 10 K decrease in the tooling temperature results in a 25 percent increase in EBT and an 8 percent increase in TIP. Material studies show that a 10 K decrease in glass transition temperature results in an 8 percent increase in EBT and a 8 percent decrease in TIP. A 20 K increase in polymer degradation temperature results in a 23 percent increase in EBT with no change in TIP.
Author
Sensitivity; Thermoplasticity; Tapes; In Situ Measurement; Automatic Control; Mathematical Models; Composite Materials

20040110279 NASA Langley Research Center, Hampton, VA, USA
Composite Properties of Polyimide Resins Made From 'Salt-Like' Solution Precursors
Cano, Roberto J.; Weiser, Erik S.; SaintClair, Terry L.; Echigo, Yoshiaki; Kaneshiro, Hisayasu; [1997]; 13 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Recent work in high temperature materials at NASA Langley Research Center (LaRC (trademark)) have led to the development of new polyimide resin systems with very attractive properties. The majority of the work done with these resin systems has concentrated on determining engineering mechanical properties of composites prepared from a poly(amide acid) precursor. Three NASA Langley-developed polyimide matrix resins, LaRC (trademark) -IA, LaRC (trademark) -IAX, and LaRC (trademark) -8515, were produced via a salt-like process developed by Unitika Ltd. The 'salt-like' solutions (sixty-five percent solids in NMP) were prepregged onto Hexcel IM7 carbon fiber using the NASA LaRC Multipurpose Tape Machine. Process parameters were determined and composite panels fabricated. Mechanical properties are presented for these three intermediate modulus carbon fiber/polyimide matrix composites and compared to existing data on the same polyimide resin systems and IM7 carbon fiber manufactured via poly(amide acid) solutions (thirty-five percent solids in NMP). This work studies the effects of varying the synthetic route on the processing and mechanical properties of polyimide composites.
Author
Polyimide Resins; Fabrication; Resin Matrix Composites; Fiber Composites

20040110329 NASA Langley Research Center, Hampton, VA, USA
Start-On-The-Part Transient Model for In-Situ Automated Tape Placement of Thermoplastic Composites
Costen, Robert c.; Marchello, Joseph M.; [1997]; 15 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Fabrication of a complex part by automated tape placement (ATP) can require starting up a new tape-end in the part interior, termed start-on-the-part. Careful thermal management of the starting transient is needed to achieve uniform crystallinity and inter-laminar weld strength - which is the objective of this modeling effort. The transient is modeled by a Fourier-Laplace transform solution of the time-dependent thermal transport equation in two spatial dimensions. The solution is subject to a quasi-steady approximation for the speed and length of the consolidation head. Sample calculations are done for the Langley ATP robot applying PEEK/carbon fiber composite and for two upgrades in robot performance. The head starts out almost at rest which meets an engineering requirement for accurate placement of the new tape-end. The head then rapidly accelerates until it reaches its steady state speed. This rapid acceleration, however, violates the quasi-steady approximation, so uniform weld strength and crystallinity during the starting transient are not actually achieved. The solution does give the elapsed time and distance from start-up to validity of the quasi-steady approximation - which quantifies the length of the non-uniform region. The elapsed time was always less than 0.1 s and the elapsed distance less than 1 cm. This quantification would allow the non-uniform region to be either trimmed away or compensated for in the design of a part. Such compensation would require experiments to measure the degree of non-uniformity, because the solution does not provide this information. The rapid acceleration suggests that the consolidation roller or belt be actively synchronized to avoid abrading the tape.
Author
Tapes; Peek; Carbon Fibers; Fiber Composites; Resin Matrix Composites

20040110356 NASA Langley Research Center, Hampton, VA, USA
Ultrasonic Studies of Composites Undergoing Thermal and Fatigue Loading
Madaras, Eric I.; Winfree, William P.; Johnston, Patrick H.; [1997]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

New composite materials possess attractive properties for use in advanced aircraft. A necessary requirement for their introduction into aeronautic use is an accurate understanding of their long term aging processes so that proper design criteria

can be established. In order to understand those properties, these composites must be exposed to thermal and load cycles that are characteristic of flight conditions. Additionally, airline companies will require nondestructive evaluation (NDE) methods that can be used in the field to assess the condition of these new materials as they age. As part of an effort to obtain the required information about new composites for aviation use, we are performing ultrasonic measurements both in the NDE laboratory and in the materials testing laboratory at NASA. The materials testing laboratory is equipped with environmental chambers mounted on load frames so that composite samples can be exposed to thermal and loading cycles representative of flight protocols. Applying both temperature and load simultaneously will help to highlight temperature and load interactions during the aging of these composite materials. This study reports on our initial ultrasonic attenuation results from thermoset and thermoplastic composite samples. Ultrasonic attenuation measurements have been used reliably to assess the effects of material degradation. For example, recently, researchers have shown that by using frequencies of ultrasound on the order of 24 MHz, they could obtain adequate contrast in the evaluation of thermal degradation in these composites. This paper will present data that shows results at a lower frequency range. In addition, we report results on the frequency dependence of attenuation as the slope of attenuation with respect to frequency, beta = delta alpha (f) / delta f. The slope of attenuation is an attractive parameter since it is quantitative, yet does not require interface corrections like conventional quantitative attenuation measurements. This is a consequence of the assumption that interface correction terms are frequently independent. Uncertainty in those corrections terms compromises the value of conventional quantitative attenuation data.
Derived from text
Composite Materials; Fatigue (Materials); Loads (Forces); Thermal Degradation; Ultrasonics; Attenuation

20040110380 NASA Langley Research Center, Hampton, VA, USA
The Wettability of LaRC Colorless Polyimide Resins on Casting Surfaces
Miner, Gilda A.; Stoakley, Diane M.; St.Clair, Anne K.; Gierow, Paul A.; Bates, Kevin; [1997]; 6 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Two colorless polyimides developed at NASA Langley Research Center, LaRC -CP1 and LaRC -CP2, are noted for being optically transparent, resistant to radiation, and soluble in the imide form. These materials may be used to make transparent, thin polymer films for building large space reflector/collector inflatable antennas, solar arrays, radiometers, etc. Structures such as these require large area, seamless films produced via spin casting or spray coating the soluble imide on a variety of substrates. The ability of the soluble imide to wet and spread over the mandrel or casting substrate is needed information for processing these structures with minimum waste and reprocessing, thereby, reducing the production costs. The wettability of a liquid is reported as the contact angle of the solid/liquid system. This fairly simple measurement is complicated by the porosity and the amount of contamination of the solid substrate. This work investigates the effect of inherent viscosity, concentration of polyimide solids, and solvent type on the wettability of various curing surfaces.
Derived from text
Casting; Polyimide Resins; Wettability; Substrates; Surface Properties

20040110399 National Academy of Sciences - National Research Council, Hampton, VA, USA
Comparison of Mode II and III Monotonic and Fatigue Delamination Onset Behavior for Carbon/Toughened Epoxy Composites
Li, Jian; OBrien, T. Kevin; Lee, Shaw Ming; [1997]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Monotonic and fatigue tests were performed to compare the Mode II and III interlaminar fracture toughness and fatigue delamination onset for Tenax-HTA/R6376 carbon/toughened epoxy composites. The Mode II interlaminar fracture toughness and fatigue delamination onset were characterized using the end-notched flexure (ENF) test while the Mode III interlaminar fracture toughness and fatigue delamination onset were characterized by using the edge crack torsion (ECT) test. Monotonic tests show that the Mode III fracture toughness is higher than the Mode II fracture toughness. Both Mode II and III cyclic loading greatly increases the tendency for a delamination to grow relative to a single monotonically increasing load. Under fatigue loading, the Mode III specimen also has a longer life than the Mode II specimen.
Author
Delaminating; Fatigue Tests; Fracture Strength; Mechanical Properties; Interlaminar Stress; Epoxy Matrix Composites

20040110403 NASA Langley Research Center, Hampton, VA, USA
Automated Fabrication of High Performance Composites: An Overview of Research at the Langley Research Center
Johnston, N. J.; Towell, T. W.; Marchello, J. M.; Grenoble, R. W.; [1997]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Automated heated placement of consolidated fiber reinforced polymer ribbon/tape is a rapid, cost effective technique for net shape fabrication of high performance composites. Several research efforts in the USA are developing the heated head robotic hardware and associated software needed to bring this technology into widespread use for building aircraft parts. These efforts emphasize the use of pre-consolidated thermoplastic ribbon or tape which is thermally welded on-the-fly . The approach provides in-situ consolidation and obviates the need for autoclave processing and massive debulking, thereby reducing costs. Addressed in this paper are some key issues being pursued at NASA Langley related to this technology. These include: (a) preparation of high quality intermediate materials forms such as thermoplastic powders, powder-coated towpreg and consolidated ribbon/tape and (b) achievement of precise control of the following: robot head positioning on the tool; material placement; heat delivery to the lay-down zone; and cut/add, start/stop capability. Heated head development has dealt with the use of hot gases alone and in combination with focused infrared radiation as heat sources.
Author
Fiber Composites; Fabrication; Thermoplasticity; Autoclaves

20040110409 NASA Langley Research Center, Hampton, VA, USA
Mechanics Methodology for Textile Preform Composite Materials
Poe, Clarence C., Jr.; [1996]; 17 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

NASA and its contractors have completed a program to develop a basic mechanics underpinning for textile composites. Three major deliverables were produced by the program: 1. A set of test methods for measuring material properties and design allowables; 2. Mechanics models to predict the effects of the fiber preform architecture and constituent properties on engineering moduli, strength, damage resistance, and fatigue life; and 3. An electronic data base of coupon type test data. This report describes these three deliverables.
Author (revised)
Composite Materials; Preforms; Textiles; Methodology; Mechanical Properties

20040110418 NASA Langley Research Center, Hampton, VA, USA
Applications of Advanced, Waveform Based AE Techniques for Testing Composite Materials
Prosser, William H.; Proceedings of the SPIE Conference on Nondestructive Evaluation Techniques for Aging Infrastructure and Manufacturing: Materials and Composites; [1996], pp. 146-153; In English; SPIE Conference on Nondestructive Evaluation Techniques for Aging Infrastructure and Manufacturing: Materials and Composites, 2-5 Dec. 1996, Scottsdale, AZ, USA; No Copyright; Avail: CASI; A02, Hardcopy

Advanced, waveform based acoustic emission (AE) techniques have been previously used to evaluate damage progression in laboratory tests of composite coupons. In these tests, broad band, high fidelity acoustic sensors were used to detect signals which were then digitized and stored for analysis. Analysis techniques were based on plate mode wave propagation characteristics. This approach, more recently referred to as Modal AE, provides an enhanced capability to discriminate and eliminate noise signals from those generated by damage mechanisms. This technique also allows much more precise source location than conventional, threshold crossing arrival time determination techniques. To apply Modal AE concepts to the interpretation of AE on larger composite structures, the effects of wave propagation over larger distances and through structural complexities must be well characterized and understood. In this research, measurements were made of the attenuation of the extensional and flexural plate mode components of broad band simulated AE signals in large composite panels. As these materials have applications in a cryogenic environment, the effects of cryogenic insulation on the attenuation of plate mode AE signals were also documented.
Author
Acoustic Emission; Composite Materials; Waveforms; Acoustic Attenuation

20040110808 NASA Langley Research Center, Hampton, VA, USA
Damage Initiation and Ultimate Tensile Strength of Scaled [0 deg n/90 deg n/0 deg n]sub T Graphite-Epoxy Coupons
Jackson, Karen E.; Prosser, William H.; [1997]; 14 pp.; In English; 14th US Army Symposium on Solid Mechanics; No Copyright; Avail: CASI; A03, Hardcopy

Previous research on scaling effects in composite materials has demonstrated that the stress levels at first ply failure and ultimate failure of composite laminates are dependent on the size of the laminate. In particular, the thickness dimension has been shown to be the most influential parameter in strength scaling of composite coupons loaded in tension. Geometrically and constitutively scaled laminates exhibit decreasing strength with increasing specimen size, and the magnitude of the strength-size effect is a function of both material properties and laminate stacking sequence. Some of the commonly used

failure criteria for composite materials such as maximum stress, maximum strain, and tensor polynomial (e.g., Tsai-Wu) cannot account for the strength-size effect. In this paper, three concepts are developed and evaluated for incorporating size dependency into failure criteria for composite materials. An experimental program of limited scope was performed to determine the first ply failure stress in scaled cross-ply laminates loaded in tension. Test specimens were fabricated of AS-4/3502 graphite-epoxy composite material with laminate stacking sequences of [0 deg n/90 deg n/o deg n]subT where n=1-6. Two experimental techniques were used to determine first ply failure, defined as a transverse matrix crack in the 90 deg ply: (1) step loading with dye penetrant x-ray of the specimen at each load interval, and (2) acoustic emission. The best correlation between first ply failure analysis and experimental data was obtained using a modified Weibull approach which incorporated the residual thermal stress and the outer ply constraint, as well as the ply thickness effect. Finally, a second set of experiments was performed to determine the tensile response and ultimate failure of the scaled cross-ply laminates. The results of these experiments indicated no influence of specimen size on tensile response or ultimate strength.
Author
Thickness; Composite Materials; Graphite-Epoxy Composites; Acoustic Emission; Cracks; Laminates; Loads (Forces); Stress-Strain Relationships

20040110835 NASA Glenn Research Center, Cleveland, OH, USA
Thermal and Environmental Barrier Coatings for Advanced Propulsion Engine Systems
Zhu, Dong-Ming; Miller, Robert A.; August 2004; 18 pp.; In English; 60th Annual Forum and Technology Display, 7-10 Jun. 2004, Baltimore, MD, USA
Contract(s)/Grant(s): WBS 22-714-30-09; DA Proj. 1L1-62211-A-74-A
Report No.(s): NASA/TM-2004-213129; ARL-TR-3263; E-14622; No Copyright; Avail: CASI; A03, Hardcopy

Ceramic thermal and environmental barrier coatings (TEBCs) are used in gas turbine engines to protect engine hot-section components in the harsh combustion environments, and extend component lifetimes. For future high performance engines, the development of advanced ceramic barrier coating systems will allow these coatings to be used to simultaneously increase engine operating temperature and reduce cooling requirements, thereby leading to significant improvements in engine power density and efficiency. In order to meet future engine performance and reliability requirements, the coating systems must be designed with increased high temperature stability, lower thermal conductivity, and improved thermal stress and erosion resistance. In this paper, ceramic coating design and testing considerations will be described for high temperature and high-heat-flux engine applications in hot corrosion and oxidation, erosion, and combustion water vapor environments. Further coating performance and life improvements will be expected by utilizing advanced coating architecture design, composition optimization, and improved processing techniques, in conjunction with modeling and design tools.
Author
Ceramic Coatings; Thermal Conductivity; Heat Flux; Thermal Control Coatings; Gas Turbine Engines

20040111011 NASA Glenn Research Center, Cleveland, OH, USA
Goals and Progress for Mil Handbook 17, Vol. 5 on Ceramic Matrix Composites: Testing and Characterization
Verrilli, Michael J.; Gonczy, Stephen; [2004]; 21 pp.; In English; 28th Annual Conference on Composites, Materials and Structures, 26-30 Jan. 2004, Cape Canaveral, FL, USA; Copyright; Avail: CASI; A03, Hardcopy

The initial edition of the Mil Handbook 17, Vol. 5 on ceramic matrix composites (CMCs) was recently published. Part C of this CMC volume describes procedures for characterization of the thermal, physical, and mechanical properties of CMCs and subsequent data analysis procedures. As is the case for entire CMC volume, this chapter is a 'work in progress' with sections on recommended test plans and matrices, data reduction, and test methods. This presentation will describe the current status in development of this section of the CMC volume and will highlight examples of critical issues that will be addressed in this volume. CMC systems are a different class of material than metals or polymer matrix composite with different mechanical response and failure modes, design rules, test methods, and characterization techniques. The CMC test protocols need to include guidance on how to generate enough reliable data in order to estimate, with reasonable confidence, the lower bounds of performance properties, such as strength and life. Strength data sets on two material systems, C/SiC and Nicalon/SiNC, and a creep rupture data set on C/SiC, will be presented to highlight this issue. The structural properties of CMC parts can sometimes be significantly different than those obtained from flat panels because of changes in fiber architecture often required to make shapes and spatial and lot-to-lot variations in processing conditions. To illustrate an example, the hoop tensile properties of SiC/SiC cylinders will be compared to properties obtained from flat panels fabricated from the same composites. These CMC testing-design issues are being defined and documented in the Mil Handbook 17 CMC volume.
Author
Ceramic Matrix Composites; Fabrication; Mechanical Properties; Characterization; Handbooks

25
INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

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

20040095938 NASA Langley Research Center, Hampton, VA, USA
Chemistry, Adhesive and Composite Properties of Low Molecular Weight Phenylethynyl Terminated Oligomers
Connell, John W.; January 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

PETI-5 (1250 and 2500 g/mole) were prepared and characterized. Neat resin, adhesive and composite properties were determined and compared with those of PETI-5 (5000 g/mole). Relative to PETI-5 (5000 g/mole), PETI-5 (2500 g/mole) exhibited improved processability and equivalency in the adhesive and composite properties measured thus far. This resin, in both adhesive film and prepreg form, has the potential to offer significant improvements in the processing of complex structural composite parts.
Author
Adhesives; Low Molecular Weights; Oligomers; Phenyls; Composite Materials; Mechanical Properties; Synthesis (Chemistry)

20040100749 Stanford Univ., Stanford, CA, USA
Biodegradation of Chlorinated Solvents: Reactions near Dnapl and Enzyme Function
McCarty, P. L.; Spormann, A. M.; Criddle, C. S.; Dec. 11, 2003; In English
Report No.(s): DE2003-820096; No Copyright; Avail: National Technical Information Service (NTIS)

Chlorinated solvents are among the most widespread groundwater contaminants in the country, contamination which is also among the most difficult and expensive for remediation. These solvents are biodegradable in the absence of oxygen, but this biodegradation requires both a food source for the organisms (electron donor) and the presence of chlorinated solvent biodegrading organisms. These two requirements are present naturally at some contamination sites, leading to natural attenuation of the solvents. If one or both requirements are absent, then engineered bioremediation either through addition of an external electron donor or through bioaugmentation with appropriate microorganisms, or both, may be used for site remediation. The most difficult case for cleanup is when a large residual of undissolved chlorinated solvents are present, residing as dense -non-aqueous-phase- liquid (DNAPL). A major focus of this study was on the potential for biodegradation of the solvents when present as DNAPL where concentrations are very high and potential for toxicity to microorganisms exist. Another focus was on a better understanding of the biological mechanisms involved in chlorinated solvent biodegradation . These studies were directed towards the chlorinated solvents, trichloroethene (TCE), tetrachloroethene or perchloroethene (PCE), and carbon tetrachloride (CT).
NTIS
Solvents; Chlorination; Contaminants; Ground Water; Carbon Tetrachloride; Biodegradability

20040110259 NASA Langley Research Center, Hampton, VA, USA
Cure Chemistry of Phenylethynyl Terminated Oligomers
Wood, Karen H.; Orwoll, Robert A.; Young, Philip R.; Jensen, Brian J.; McNair, Harold M.; [1997]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The ability to process high performance polymers into quality, void-free composites has been significantly advanced using oligomers terminated with reactive groups which cure or crosslink at elevated temperature without the evolution of volatile byproducts. Several matrix resin systems of considerable interest to the aerospace community utilize phenylethynyl-terminated imide (PETI) technology to achieve this advantage. The present paper addresses the cure chemistry of PETI oligomers. The thermal cure of a low molecular weight model compound was studied using a variety of analytical techniques including differential scanning calorimetry, Fourier transform infrared spectroscopy, and liquid chromatography-mass spectroscopy. The studies indicate an extremely complex cure process. Many stable products were isolated and this paper reports current work on identification of those products. The intent of this research is to provide fundamental insight into the molecular structure of the cured PETI engineering materials so that performance and durability can be more fully assessed.
Author
Oligomers; Phenyls; Polyimides; Synthesis (Chemistry); Chemical Compounds

20040110273 NASA Langley Research Center, Hampton, VA, USA

The Effect of Molecular Weight on the Composite Properties of Cured Phenylethynyl Terminated Imide Oligomers

Smith, J. G., Jr.; Connell, J. W.; Hergenrother, P. M.; [1997]; 13 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

As part of a program to develop high temperature/high performance structural resins for aeronautical applications, imide oligomers containing terminal phenylethynyl groups with calculated number average molecular weights of 1250, 2500 and 5000 g/mol were prepared, characterized, and evaluated as adhesives and composite matrix resins. The goal of this work was to develop resin systems that are processable using conventional processing equipment into void free composites that exhibit high mechanical properties with long term high temperature durability, and are not affected by exposure to common aircraft fluids. The imide oligomers containing terminal phenylethynyl groups were fabricated into titanium adhesive specimens and IM-7 carbon fiber laminates under 0.1 - 1.4 MPa for 1 hr at 350-371 C. The lower molecular weight oligomers exhibited higher cured Tg, better processability, and better retention of mechanical properties at elevated temperature without significantly sacrificing toughness or damage tolerance than the higher molecular weight oligomer. The neat resin, adhesive and composite properties of the cured polymers will be presented.

Author

Imides; Mechanical Properties; Molecular Weight; Oligomers; Phenyls; Composite Materials; Resin Matrix Composites; Fabrication

20040110338 NASA Langley Research Center, Hampton, VA, USA

Adhesive Properties of Cured Phenylethynyl Containing Imides

Jensen, Brian J.; Chang, Alice C.; [1997]; 3 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

Considerable attention has been directed towards acetylene terminated oligomers over the last 20 years' and recent work has focused on phenylethynyl terminated imide (PETI) oligomers. These reactive oligomers possess several features which make them attractive candidates for use as composite matrices and adhesives. The phenylethynyl group can be readily incorporated into many different functionalized oligomers. The reactive oligomers possess relatively low melt viscosities and thermally cure without the evolution of volatile by-products. Once cured, they typically display high glass transition temperatures (Tgs), excellent solvent resistance and high mechanical properties. new modified phenylethynyl-terminated imide (LaRC MPEI) oligomers were synthesized at various molecular weights utilizing a small amount of trifunctional amine. As long as the amount of triamine is relatively small, this approach produces a mixture of linear, star-shaped and branched polymer chains that has lower melt and solution viscosity than an equivalent molecular weight linear phenylethynyl terminated imide oligomers. The work reported herein involves the synthesis and characterization of a copolymer using this approach and the preparation of blends utilizing a phenylethynyl containing reactive plasticizer of lower molecular weight called LaRC LV-121. The chemistry and properties of this new MPEI as well as some blends of MPEI with LV-121, are presented and compared to the linear version, LARC-PETI-5.

Derived from text

Adhesives; Imides; Phenyls; Oligomers; Synthesis (Chemistry); Copolymers

20040110527 Air Force Research Lab., Hanscom AFB, MA

Quantitative Detection of Single O2 by Cavity- Enhanced Absorption

Williams, Skip; Gupta, Manish; Owano, Thomas; Baer, Douglas S.; O'Keefe, Anthony; Dec. 11, 2003; 4 pp.; In English

Contract(s)/Grant(s): Proj-2303

Report No.(s): AD-A425516; AFRL-VS-HA-TR-2004-1134; No Copyright; Avail: CASI; A01, Hardcopy

A method for the practical determination of the absolute concentration of single alpha(exp 1) DELTA(sub g) oxygen is discussed. The method is based on sensitive, off- axis integrated-cavity-output spectroscopy (ICOS). Off-axis ICOS allows narrowband, continuous-wave lasers to be used in conjunction with optical cavities to record sensitive absorption measurements. The details of the method as well as spectroscopic data confirming the first observation of the (1, 0) band of the beta(exp 1) SIGMA(sub g)(exp +) - alpha(exp 1) DELTA(sub g) Noxon system are presented. The absolute transition probabilities for the beta(exp 1) SIGMA(sub g)(exp +) - alpha(exp 1) DELTA(sub g) Noxon system, which are not known precisely from experiments, are determined by quantum chemistry theory. (3 figures, 19 refs.)

DTIC

Absorption Spectra; Cavities; Chemical Composition; Concentration (Composition); Emission Spectra; Laser Cavities; Oxygen

20040110637 Lawrence Livermore National Lab., Livermore, CA
Microfluidic Hydrogen Generator for Fuel Cell Applications
Bennett, W.; Chung, J.; Greif, R.; Grigoropoulos, C. P.; Harvey, C.; Sep. 16, 2003; 14 pp.; In English
Report No.(s): DE2004-15007539; UCRL-JC-148043; No Copyright; Avail: Department of Energy Information Bridge
A study of the reaction rates, heat and mass transfer and flow, in and from a methanol reforming catalytic micro-reactor fabricated on a silicon wafer is presented. Comparison of computed and measured conversion efficiencies are shown to be favorable
NTIS
Fuel Cells; Heat Transfer; Hydrogen Fuels; Generators

20040110697 Westinghouse Savannah River Co., Aiken, SC, USA
Investigation of the Corrosivity of the Vapor Phase Over High-Level Radioactive Waste
Subramanian, K. H.; Zapp, P. E.; 2003; 16 pp.; In English
Report No.(s): DE2004-806917; WSRC-MS-2002-00918; No Copyright; Avail: Department of Energy Information Bridge
Corrosion in the vapor space and at the liquid/air interface of the Department of Energy high level waste tanks have emerged as a potentially aggressive degradation mechanism.
NTIS
Corrosion; Radioactive Wastes

20040110700 Westinghouse Savannah River Co., Aiken, SC, USA
Test Plan to Update SRS HLW Tank Material Properties Database by Determining Synergistic Effects of Dynamic Strain Aging and Stress Corrosion Cracking
Subramanian, K. H.; Dec. 2001; In English
Report No.(s): DE2004-799694; WSRC-TR-2001-00590; No Copyright; Avail: National Technical Information Service (NTIS)
The structural integrity of High Level Waste (HLW) tanks is defined by the demonstrated confinement of the waste by the tank structure under design basis conditions. The validity of a structural integrity assessment depends on the availability of a reliable mechanical and corrosion property database and require application of contemporary fracture analyses. In addition, accurate characterizations of the active degradation/corrosion mechanisms are necessary to ensure structural integrity throughout the intended life of the HLW tanks. A complete mechanical and corrosion property database will provide the foundation for a robust structural integrity assessment. The focus of the proposed work was to quantify the degradation mechanisms and the effect of dynamic strain aging (DSA) on the mechanical properties and degradation mechanisms, particularly stress corrosion cracking(SCC), in low carbon steel that is reflective of tank material. A comprehensive test plan is presented here to develop a mechanical and corrosion properties database to develop a fundamental understanding of the synergistic effects of DSA and SCC due to high temperature service of the HLW tanks.
NTIS
Corrosion; Radioactive Wastes

20040110701 Savannah River Ecology Lab., Aiken, SC, USA
B-25 Corrosion Evaluation Summary Report (U)
Dunn, K. A.; Jan. 2002; In English
Report No.(s): DE2004-799678; WSRC-TR-2001-00587; No Copyright; Avail: National Technical Information Service (NTIS)
A destructive examination of a B-25 waste storage container that was buried in a shallow non-radiological land burial facility for approximately 8 years showed that pitting was the most prevalent form of corrosion and suggested that continued burial would result in through-wall pits after 30 years. This result suggests that through wall pits will provide a path for water flow into and out of similar B-25 containers after approximately 30 years of burial. Pitting was the most severe on the exterior of the lid. However, the lid had collapsed into the container, probably because the soil loading exceeded the support capacity of the lid. This observation demonstrates that lid strength is a significant factor when assessing structural integrity of the B-25 containers. The lid had collapse had allowed the container to fill with soil and water.
NTIS
Corrosion; Containers; Structural Failure

20040110764 Lawrence Livermore National Lab., Livermore, CA
Hydrogen Induced Cracking in Titanium Drip Shield of High-Level Waste Repository
Lu, S. C.; May 30, 2001; 18 pp.; In English
Report No.(s): DE2004-15005125; UCRL-JC-143999; No Copyright; Avail: Department of Energy Information Bridge

Both qualitative and quantitative assessments have been conducted to evaluate the effects of hydrogen induced cracking on the drip shield. The basic premise of the assessments is that failure will occur once the hydrogen content exceeds a certain limit or critical value, H(sub c). Potential mechanisms for hydrogen absorption in the drip shield have been identified to be general passive corrosion and galvanic couple with steel components. Both qualitative and quantitative evaluations indicated that hydrogen concentration in the drip shield will be below the critical value by a considerable margin. The choice of the mathematical models and associated parameters appears to be reasonable. Continued effort in data collection and development should provide validation and improved level of confidence of the proposed models.
NTIS
Failure; Hydrogen; Crack Initiation; Titanium; Shielding

20040110998 NASA Langley Research Center, Hampton, VA, USA
Observation of Vibrational Relaxation Dynamics in X(sup 3)Sigma(sup -)(sub g) Oxygen Following Stimulated Raman Excitation to the v=1 Level: Implications for the RELIEF Flow Tagging Technique
Diskin, Glenn S.; Lempert, Walter R.; Miles, Richard B.; [1996]; 12 pp.; In English; 34th Aerospace Sciences Meeting and Exhibit, 15-18 Jan. 1996, Reno, NV, USA
Report No.(s): AIAA Paper 96-0301; Copyright; Avail: CASI; A03, Hardcopy

The vibrational relaxation of ground-state molecular oxygen (O2, X(sup 3)Sigma(sup -)(sub g)) has been observed, following stimulated Raman excitation to the first excited vibrational level (v=1). Time delayed laser-induced fluorescence probing of the ro-vibrational population distribution was used to examine the temporal relaxation behavior. In the presence of water vapor, the relaxation process is rapid, and is dominated by near-resonant vibrational energy exchange between the v=1 level of O2 and the n2 bending mode of H2O. In the absence of H2O, reequilibration proceeds via homogeneous vibrational energy transfer, in which a collision between two v=1 O2 molecules leaves one molecule in the v=2 state and the other in the v=0 state. Subsequent collisions between molecules in v=1 and v\g1 result in continued transfer of population up the vibrational ladder. The implications of these results for the RELIEF flow tagging technique are discussed.
Author
Molecular Relaxation; Oxygen; Ground State; Molecular Excitation

20040111023 Clark-Atlanta Univ., GA, USA
Development of Thermally Stable and Highly Fluorescent IR Dyes
Bu, Xiu R.; August 2004; 17 pp.; In English
Contract(s)/Grant(s): NCC3-910; No Copyright; Avail: CASI; A03, Hardcopy

Fluorophores are the core component in various optical applications such as sensors and probes. Fluorphores with low-energy or long wavelength emission, in particular, in NIR region, possess advantages of low interference and high sensitivity. In this study, we has explored several classes of imidazole-based compounds for NIR fluorescent properties and concluded: (1) thiazole-based imidazole compounds are fluorescent; (2) emission energy is tunable by additional donor groups; (3) they also possess impressive two- photon absorption properties; and (4) fluorescence emission can be induced by two- photon input. This report summarizes (1) synthesis of new series of fluorophore; (2) impact of electron-withdrawing groups on fluorescent property; (3) unique property of two-photon absorption; and (4) on-going development.
Derived from text
Dyes; Fluorescence; Thermal Stability; Near Infrared Radiation

26
METALS AND METALLIC MATERIALS

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

20040095952 NASA Langley Research Center, Hampton, VA, USA
Development of Very Low Frequency Self-Nulling Probe for Inspection of Thick Layered Aluminum Structures
Wincheski, Buzz; Namkung, Min; [1998]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

It is clear from simple skin depth considerations that steady state electromagnetic inspection of thick multi-layered

conductors requires low frequency excitation. Conventional pickup sensors, however, lose sensitivity at lower frequencies. Giant magneto resistive materials offer a unique alternative for very low frequency electromagnetic NDE due to their high sensitivity to low frequency fields, small size, ease of use, and low cost. This paper outlines the development and testing of a Very Low Frequency Self-Nulling Probe incorporating a GMR sensor. The initial test results show flaw detectability at depths up to 1 cm in aluminum 2024. Optimization of the probe design based upon finite element modeling and GMR sensor characteristics (including hysteresis, linearity and saturation) is under way.
Author
Aluminum; Very Low Frequencies; Metal Surfaces; Probes

20040100754 Carnegie-Mellon Univ., Pittsburgh, PA
Conservation Research and Development/New Ultra-Low Carbon High Strength Steels with Improved Bake Hardenability for Enhanced Stretch Formability and Dent Resistance
DeArdo, A. J.; Garcia, C. I.; Dec. 15, 2003; In English
Report No.(s): DE2003-820518; No Copyright; Avail: National Technical Information Service (NTIS)

The major objectives of this program were to investigate the bake hardening (BH) mechanism in ultra-low carbon (ULC) steels and use the better understanding of this mechanism to design and process a new generation of bake hardening steels for automotive applications. These new steels will be thoroughly characterized in terms of their microstructure, formability, BH response, and tensile properties.
NTIS
Baking; High Strength Steels; Tensile Properties

20040100768 Westinghouse Savannah River Co., Aiken, SC, USA
Low Cycle Fatigue Analysis of Storage Canisters Due to Expansion of Contents
Flanders, H. E.; 2003; In English
Report No.(s): DE2004-820403; WSRC-MS-2003-00845; No Copyright; Avail: National Technical Information Service (NTIS)

Qualification of storage canisters due to the expansion behavior of plutonium metal during phase transitions requires a combined experimental and analytical modeling effort. Tests were conducted at Los Alamos National Laboratory to define the expansion behavior of plutonium metal during the alpha-beta-gamma phase transitions. Test results showed that the expansion is anisotropic due to the container wall constraint. The plutonium expansion parameters were calculated from test data, and combined with a finite element analysis to determine the stress state of the storage canisters. Strain values were computed and compared with the ASME Code secondary and peak stress limits. Since the applied expansion strain exceeds the strain of 10 cycles in the ASME Code design fatigue curve, the ASME Code design fatigue curve was extended to values below 10 cycles.
NTIS
Plutonium; Cans; Storage

20040110410 NASA Langley Research Center, Hampton, VA, USA
Prediction of Crack Growth under Variable-Amplitude Loading in Thin-Sheet 2024-T3 Aluminum Alloys
Newman, J. C., Jr.; [1997]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The present paper is concerned with the application of a 'plasticity-induced' crack closure model to study fatigue crack growth under various load histories. The model was based on the Dugdale model but modified to leave plastically deformed material in the wake of the advancing crack. The model was used to correlate crack growth rates under constant-amplitude loading and then used to predict crack growth under variable-amplitude and spectrum loading on thin-sheet 2024- T3 aluminum alloys. Predicted crack-opening stresses agreed well with test data from the literature. The crack-growth lives agreed within a factor of two for single and repeated spike overloads/underloads and within 20 percent for spectrum loading. Differences were attributed to fretting-product-debris-induced closure and three-dimensional affects not included in the model.
Author
Crack Propagation; Fatigue (Materials); Aluminum Alloys; Variable Amplitude Loading

20040110599 Alabama Univ., Birmingham, AL, USA
Machinable, Thin-Walled, Gray and Ductile Iron Casting Production, Phase III
Bates, C.; Trimberger, R.; Twitchell, K.; Dec. 08, 2003; In English
Report No.(s): DE2003-820535; No Copyright; Avail: National Technical Information Service (NTIS)

This report presents the results of research conducted to determine the effects of normal and abnormal processing and compositional variations on machinability (tool wear rate) of gray and ductile iron. The procedures developed allow precise tool wear measurements to be made and interpreted in terms of microstructures and compositions. Accurate data allows the most efficient ways for improving machinability (without sacrificing properties) to be determined.
NTIS
Iron; Ductility; Thin Walls; Machining; Casting

20040110604 Institute of Gas Technology, Chicago, IL, USA, Kaiser Aluminum and Chemical Corp., Oakland, CA, USA, Westinghouse Electric Corp., Boulder, CO, USA
Development of a Novel Non-Consumable Anode for Electrowinning Primary Aluminum
Robinson, T.; Yankeelov, J.; Dec. 04, 2003; In English
Report No.(s): DE2003-820534; No Copyright; Avail: National Technical Information Service (NTIS)
The principal goal of the project was to determine through theoretical considerations and from chemical and electrochemical laboratory studies the technical and economic feasibility for the substitution and retrofitting of an SOFC-type anode for today's carbon anode in a cell for electrowinning primary Al. However, solubility measurements showed that no value of cryolite ratio can exist where the solubilities of the solid electrolyte components (zirconia and especially yttria) would be small relative to the alumina solubility. Therefore, the utilization of the proposed SOFC-type anode cannot be realized for any cell involving a cryolite-base solvent. However, the project suggested that the SOFC-type anode scheme might be successful if the solvent/electrolyte for electrowinning Al could be changed to a fused sulfate melt.
NTIS
Numerical Analysis; Chemical Analysis; Electrochemical Synthesis; Feasibility Analysis; Economic Analysis; Carbon; Anodes

20040110677 Lawrence Livermore National Lab., Livermore, CA
Interim Report on Task 1.2: Near Equilibrium Processing Requirements - Attrition Milling Part 1 of 2 to Lawrence Livermore National Laboratory for Contract B345772
Stewart, M. W. A.; Vance, E. R.; Day, R. A.; Eddowes, E.; Moricca, S.; Apr. 30, 2000; 34 pp.; In English
Report No.(s): DE2004-15007289; UCRL-CR-139073-PT1; No Copyright; Avail: Department of Energy Information Bridge
The objective of Task 1.2 has only partly been achieved as the work on Pu/U-formulations and to a significant degree on Th/U-formulations has been performed under grinding/blending conditions that did not replicate plant-like fabrication processes, particularly in the case with the small glovebox attritor. Nevertheless the results do show that actinide-rich particles, not present in specimens made via the alkoxide-route (equilibrium conditions), occur when the grinding process is not efficient enough to ensure that high-fired PuO2, ThO2 and UO2 particles are below a critical size. Our current perception is that the critical size for specimens sintered at 1350 C for 4 hours is about 5 microns in diameter. The critical size is difficult to estimate, as it is equal to the starting diameter of actinide oxides just visible within brannerite regions. Our larger scale attritor experiments as well as experience with wet and dry ball milling suggests that acceptable mineralogy and microstructure can be obtained by dry milling via attritor and ball mills. This is provided that appropriate attention is paid to the size and density of the grinding media, grinding additives that reduce caking of the powder, and in the case of attritors the grinding speed and pot setup. The ideal products for sintering are free flowing granules of(approx) 100 microns containing constituents ground to about 1(micro)m to ensure homogeneity and equilibrium mineralogy.
NTIS
Grinding (Comminution); Powder (Particles); Microstructure; Uranium Oxides; Thorium Oxides

20040110694 Savannah River Ecology Lab., Aiken, SC, USA
Analytical Model for PRediction of Plate-Specific Fracture Toughness Properties of ASTM A285 Steel
Subramanian, K. H.; Wiersma, B. J.; Duncan, A. J.; Harris, S. P.; 2004; 14 pp.; In English
Report No.(s): DE2004-806918; WSRC-MS-2002-00919; No Copyright; Avail: Department of Energy Information Bridge
A materials test program was developed to measure mechanical properties of A285 carbon steel under conditions relevant to waste storage tanks at the Savannah River Site.
NTIS
Steels; Carbon Steels; Mechanical Properties

20040110728 Westinghouse Savannah River Co., Aiken, SC, USA
Gas Generation Measurements of Scrap Pu/U Materials Using a Bell Jar
Hensel, S. J.; Hill, R. D.; Kies, J. R.; Watkins, R. W.; 2004; 10 pp.; In English
Report No.(s): DE2004-810358; No Copyright; Avail: Department of Energy Information Bridge

A bell jar is used to determine containment vessel pressurization due to gas generation from plutonium/uranium materials. Seventy eight food pack cans containing plutonium and uranium oxide bearing materials have been tested to date. Minimal change in pressure (increase or decrease) occurred in fifty one cases, depressurization occurred in seventeen cases, and pressurization occurred in ten cases. Pressurization is considered to be linked to the presence of certain impurities such as magnesium oxide.
NTIS
Plutonium Oxides; Degassing; Containment; Gas Analysis

20040110751 Westinghouse Savannah River Co., Aiken, SC, USA, Oak Ridge National Lab., TN
Characterization of Confined Pinch Welds in Type 304L Stainless Steel
Korinko, P. S.; Pechersky, M. J.; Zecha, D. J.; McKinney, G. J.; Riester, L.; 2004; 12 pp.; In English
Report No.(s): DE2004-799673; WSRC-MS-2001-00672-REV1; No Copyright; Avail: Department of Energy Information Bridge

Efforts have been undertaken to characterize the stresses induced in resistance pinch welds used to seal vessels which contain high pressure radioactive gasses. Subsequent to the weld a costly and time consuming process, known as hot air decontamination (HAD) is used to remove the radioactive gasses that are entrained in the weld and surrounding metal. A process to replace HAD is under development. To qualify this new process it must be shown that the mechanical and physical properties of the weld are substantially the same as those using HAD.. These properties include the weld microstructure and the residual stresses in the vicinity of the weld. The method of making pinch welds is first described as well as one cutting method. The methods of characterizing the weld and a comparison between cut and uncut specimens by several characterization methods are presented.
NTIS
Stainless Steels; Residual Stress; Mechanical Properties

20040110753 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Tennessee Univ., Knoxville, TN, USA, Oak Ridge National Lab., TN, Carnegie-Mellon Univ., Pittsburgh, PA, USA
Multi-teraflops Spin Dynamics Studies of the Magnetic Structure of FeMn/Co Interfaces
Canning, A.; Ujfalussy, B.; Schulthess, T. C.; Zhang, X. G.; Shelton, W. A.; 2004; In English
Report No.(s): DE2004-821446; No Copyright; Avail: National Technical Information Service (NTIS)

The authors have used the power of massively parallel computers to perform first principles spin dynamics (SD) simulations of the magnetic structure of Iron-Manganese/Cobalt (FeMn/Co) interfaces. These large scale quantum mechanical simulations, involving 2016-atom super-cell models, reveal details of the orientational configuration of the magnetic moments at the interface that are unobtainable by any other means. Exchange bias, which involves the use of an antiferromagnetic (AFM) layer such as FeMn to pin the orientation of the magnetic moment of a proximate ferromagnetic (FM) layer such as Co, is of fundamental importance in magnetic multilayer storage and read head devices. Here the equation of motion of first principles SD is used to perform relaxations of model magnetic structures to the true ground (equilibrium) state. Our code is intrinsically parallel and has achieved a maximum execution rate of 2.46 Teraflops on the IBM SP at the National Energy Research Scientific Computing Center (NERSC).
NTIS
Spin Dynamics; Magnetic Moments

20040110761 Lawrence Livermore National Lab., Livermore, CA
Analysis of Gas Pressure Forming of Superplastic AL 5083 Alloy
Syn, C. K.; O'Brien, M. J.; Lesuer, D. R.; Sherby, O. D.; May 04, 2001; 12 pp.; In English
Report No.(s): DE2004-15005152; UCRL-JC-135190; No Copyright; Avail: Department of Energy Information Bridge

Al 5083 disks of a superplastic forming grade were gas-pressure formed to hemispheres and cones at constant forming pressures with and without back pressure. The forming operation was performed using an in-house designed and built biaxial forming apparatus. The temporal change of dome heights of the hemispheres and cones were measured for the different forming and back pressures applied. The flow stresses and strain rates developed at the top of the dome during the forming

step were shown to closely follow the flow stress-strain rate relationship obtained from the strain rate change tests performed at the same temperature using uniaxial tensile samples.
NTIS
Gas Pressure; Aluminum Alloys; Superplastic Forming

20040110776 NASA Langley Research Center, Hampton, VA, USA, Army Research Lab., Hampton, VA, USA
The Effect of Hole Quality on the Fatigue Life of 2024-T3 Aluminum Alloy Sheet
Everett, Richard A., Jr.; August 2004; 15 pp.; In English
Contract(s)/Grant(s): WU 23-762-30-71
Report No.(s): NASA/TM-2004-212658; L-19011; ARL-TR-3106; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents the results of a study whose main objective was to determine which type of fabrication process would least affect the fatigue life of an open-hole structural detail. Since the open-hole detail is often the fundamental building block for determining the stress concentration of built-up structural parts, it is important to understand any factor that can affect the fatigue life of an open hole. A test program of constant-amplitude fatigue tests was conducted on five different sets of test specimens each made using a different hole fabrication process. Three of the sets used different mechanical drilling procedures while a fourth and fifth set were mechanically drilled and then chemically polished. Two sets of specimens were also tested under spectrum loading to aid in understanding the effects of residual compressive stresses on fatigue life. Three conclusions were made from this study. One, the residual compressive stresses caused by the hole-drilling process increased the fatigue life by two to three times over specimens that were chemically polished after the holes were drilled. Second, the chemical polishing process does not appear to adversely affect the fatigue life. Third, the chemical polishing process will produce a stress-state adjacent to the hole that has insignificant machining residual stresses.
Author
Aluminum Alloys; Fabrication; Fatigue Life; Metal Sheets; Mechanical Engineering; Hole Geometry (Mechanics); Residual Stress

20040110825 NASA Glenn Research Center, Cleveland, OH, USA
Effect of Surface Impulsive Thermal Loads on Fatigue Behavior of Constant Volume Propulsion Engine Combustor Materials
Zhu, Dongming; Fox, Dennis S.; Miller, Robert A.; Ghosn, Louis J.; Kalluri, Sreeramesh; August 2004; 17 pp.; In English; International Conference on Metallurgical Coatings and Thin Films, 19-23 Apr. 2003, San Diego, CA, USA
Contract(s)/Grant(s): WBS 22-708-03-04; DA Proj. 1L1-62211-A4-7A
Report No.(s): NASA/TM-2004-213084; ARL-TR-3258; E-14562; No Copyright; Avail: CASI; A03, Hardcopy

The development of advanced high performance constant-volume-combustion-cycle engines (CVCCE) requires robust design of the engine components that are capable of enduring harsh combustion environments under high frequency thermal and mechanical fatigue conditions. In this study, a simulated engine test rig has been established to evaluate thermal fatigue behavior of a candidate engine combustor material, Haynes 188, under superimposed CO2 laser surface impulsive thermal loads (30 to 100 Hz) in conjunction with the mechanical fatigue loads (10 Hz). The mechanical high cycle fatigue (HCF) testing of some laser pre-exposed specimens has also been conducted under a frequency of 100 Hz to determine the laser surface damage effect. The test results have indicated that material surface oxidation and creep-enhanced fatigue is an important mechanism for the surface crack initiation and propagation under the simulated CVCCE engine conditions.
Author
Laser Damage; Fatigue Tests; Crack Initiation; Surface Cracks; Crack Propagation; Engine Tests

20040110833 NASA Glenn Research Center, Cleveland, OH, USA
Microstructural Evaluation of KM4 and SR3 Samples Subjected to Various Heat Treatments
Ellis, David; Gabb, Timothy; Garg, Anita; August 2004; 90 pp.; In English
Contract(s)/Grant(s): WBS 22-714-09-46
Report No.(s): NASA/TM-2004-213140; E-14654; No Copyright; Avail: CASI; A05, Hardcopy

The gamma-gamma microstructures of two advanced powder metallurgy disk alloys, KM4 and SR3, were quantified after a series of heat treatments using transmission electron microscopy and image analysis. Relationships between the heat treatments and the resulting gamma distributions were evaluated. Statistical correlations between the gamma distributions and the reported tensile strengths, creep resistances, and dwell crack growth resistances were separately assessed for each alloy. To avoid the effects of grain size related mechanisms, the grain size of the samples used in the correlations for each alloy were

limited to narrow ranges of about 1.5 in ASTM grain size number. In both alloys, yield and tensile strength increased with increasing fraction of medium sized gamma. The strength increased as the size of the medium gamma decreased and the size of the fine gamma increased. Time to 0.2 percent creep in SR3 increased with increasing medium gamma volume fraction, and decreasing fine gamma sizes. However, 0.2 percent creep time was not clearly correlated with the gamma microstructures of KM4 specimens, apparently due to effects of stabilization heat treatments which greatly suppress creep resistance. Dwell fatigue crack growth rate decreased with increasing medium gamma volume fraction, indicating more medium gamma is beneficial. The crack growth rate also decreased with decreasing gamma size, indicating finer gamma is better.
Author
Microstructure; Evaluation; Heat Treatment; Temperature Effects; Creep Properties; Crack Propagation; Correlation; Gamma Rays

20040110844 NASA Glenn Research Center, Cleveland, OH, USA
Microstructural Evaluations of Baseline HSR/EPM Disk Alloys
Gabb, Timothy P.; Garg, Anita; Ellis, David L.; August 2004; 61 pp.; In English
Contract(s)/Grant(s): WBS 22-714-09-46
Report No.(s): NASA/TM-2004-213123; E-14617; No Copyright; Avail: CASI; A04, Hardcopy

Six alloys representing two classes of powder metallurgy nickel-based superalloys were examined by transmission electron microscopy (TEM) and phase extraction. Alloys KM4, CH98, IN-100 and 456 are based on a Ni-18Co-12Cr composition while alloys Rene' 88 DT and SR 3 have lower Al and Co and higher Cr contents. The lambda size distributions were determined from quantitative image analysis of the TEM images. The volume fraction of lambda and carbides and the composition of the phases were determined by a combination of phase extraction and TEM. The results showed many similarities in lambda size distributions, grain boundary serrations, and grain boundary carbide frequencies between alloys KM4, CH98, 456, Rene' 88 DT and SR 3 when heat treated to give an approximate grain size of ASTM 6. The density of grain boundary carbides in KM4 was shown to substantially increase as the grain size increased. IN-100 and 456 subjected to a serration cooling heat treatment had much more complex lambda size distributions with very large intergranular and intragranular secondary lambda as well as finer than average cooling and aging lambda. The grain boundary carbides in IN-100 were similar to the other alloys, but 456 given the serration cooling heat treatment had a more variable density of grain boundary carbides. Examination of the phases extracted from the matrix showed that there were significant differences in the phase chemistries and elemental partitioning ratios between the various alloys.
Author
Heat Resistant Alloys; Nickel Alloys; Powder Metallurgy; Transmission Electron Microscopy; Extraction; Grain Boundaries; Size Distribution

27
NONMETALLIC MATERIALS

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

20040100764 Du Pont de Nemours (E. I.) and Co., Aiken, SC, USA
Decontamination of Dissolved Salt Solution from Tank 19F Using Duolite CS-100 and Amberlite IRC-718 Resins
Lee, L. M.; May 1981; 28 pp.; In English
Report No.(s): DE2004-787807; DPST-81-329; No Copyright; Avail: Department of Energy Information Bridge

The high level alkaline waste generated at SRP is separated and stored as solid and liquid fractions in underground tanks. In the proposed flowsheet for the Defense Waste Processing Facility (DWPF), the solid fraction (sludge) will be sent to a glass melter for fixation in a borosilicate glass matrix (DWPF - Stage 1). The liquid fraction (supernate) will be processed through ion exchange columns where the major radioactive isotopes (Cs137 and Sr90) are removed (DWPF) - Stage 11. This report describes a demonstration of ion exchange decontamination of defense waste from Tank 19F in the High Level Caves (HLC).
NTIS
Decontamination; Borosilicate Glass

20040110266 NASA Langley Research Center, Hampton, VA, USA

Molecularly Oriented Polymeric Thin Films for Space Applications

Fay, Catharine C.; Stoakley, Diane M.; St.Clair, Anne K.; [1997]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The increased commitment from NASA and private industry to the exploration of outer space and the use of orbital instrumentation to monitor the earth has focused attention on organic polymeric materials for a variety of applications in space. Some polymeric materials have exhibited short-term (3-5 yr) space environmental durability; however, future spacecraft are being designed with lifetimes projected to be 10-30 years. This gives rise to concern that material property change brought about during operation may result in unpredicted spacecraft performance. Because of their inherent toughness and flexibility, low density, thermal stability, radiation resistance and mechanical strength, aromatic polyimides have excellent potential use as advanced materials on large space structures. Also, there exists a need for high temperature (200-300 C) stable, flexible polymeric films that have high optical transparency in the 300-600nm range of the electromagnetic spectrum. Polymers suitable for these space applications were fabricated and characterized. Additionally, these polymers were molecularly oriented to further enhance their dimensional stability, stiffness, elongation and strength. Both unoriented and oriented polymeric thin films were also cryogenically treated to temperatures below -184 C to show their stability in cold environments and determine any changes in material properties.

Author

Thin Films; Polymers; Polyimides; Synthesis (Chemistry); Cryogenics; Fabrication; Technology Utilization; Mechanical Properties

20040110267 NASA Langley Research Center, Hampton, VA, USA

High Temperature Structural Foam

Weiser, Erik S.; Baillif, Faye F.; Grimsley, Brian W.; Marchello, Joseph M.; [1997]; 15 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The Aerospace Industry is experiencing growing demand for high performance polymer foam. The X-33 program needs structural foam insulation capable of retaining its strength over a wide range of environmental conditions. The High Speed Research Program has a need for low density core splice and potting materials. This paper reviews the state of the art in foam materials and describes experimental work to fabricate low density, high shear strength foam which can withstand temperatures from -220 C to 220 C. Commercially available polymer foams exhibit a wide range of physical properties. Some with densities as low as 0.066 g/cc are capable of co-curing at temperatures as high as 182 C. Rohacell foams can be resin transfer molded at temperatures up to 180 C. They have moduli of elasticity of 0.19 MPa, tensile strengths of 3.7 Mpa and compressive strengths of 3.6 MPa. The Rohacell foams cannot withstand liquid hydrogen temperatures, however Imi-Tech markets Solimide (trademark) foams which withstand temperatures from -250 C to 200 C, but they do not have the required structural integrity. The research activity at NASA Langley Research Center focuses on using chemical blowing agents to produce polyimide thermoplastic foams capable of meeting the above performance requirements. The combination of blowing agents that decompose at the minimum melt viscosity temperature together with plasticizers to lower the viscosity has been used to produce foams by both extrusion and oven heating. The foams produced exhibit good environmental stability while maintaining structural properties.

Author

Refractory Materials; Foams; Fabrication

20040110285 NASA Langley Research Center, Hampton, VA, USA

Innovative Materials for Aircraft Morphing

Simpson, J. O.; Wise, S. A.; Bryant, R. G.; Cano, R. J.; Gates, T. S.; Hinkley, J. A.; Rogowski, R. S.; Whitley, K. S.; [1997]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Reported herein is an overview of the research being conducted within the Materials Division at NASA Langley Research Center on the development of smart material technologies for advanced airframe systems. The research is a part of the Aircraft Morphing Program which is a new six-year research program to develop smart components for self-adaptive airframe systems. The fundamental areas of materials research within the program are computational materials; advanced piezoelectric materials; advanced fiber optic sensing techniques; and fabrication of integrated composite structures. This paper presents a portion of the ongoing research in each of these areas of materials research.

Author

Smart Materials; Aircraft Structures; Aeroelasticity

20040110332 NASA Langley Research Center, Hampton, VA, USA
Accelerated Strength Testing of Thermoplastic Composites
Reeder, J. R.; Allen, D. H.; Bradley, W. L.; [1998]; 28 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Constant ramp strength tests on unidirectional thermoplastic composite specimens oriented in the 90 deg. direction were conducted at constant temperatures ranging from 149 C to 232 C. Ramp rates spanning 5 orders of magnitude were tested so that failures occurred in the range from 0.5 sec. to 24 hrs. (0.5 to 100,000 MPa/sec). Below 204 C, time-temperature superposition held allowing strength at longer times to be estimated from strength tests at shorter times but higher temperatures. The data indicated that a 50% drop in strength might be expected for this material when the test time is increased by 9 orders of magnitude. The shift factors derived from compliance data applied well to the strength results. To explain the link between compliance and strength, a viscoelastic fracture model was investigated. The model, which used compliance as input, was found to fit the strength data only if the critical fracture energy was allowed to vary with temperature reduced stress rate. This variation in the critical parameter severely limits its use in developing a robust time-dependent strength model. The significance of this research is therefore seen as providing both the indication that a more versatile acceleration method for strength can be developed and the evidence that such a method is needed.
Author
Accelerated Life Tests; Thermoplasticity; Temperature Effects; Viscoelasticity

20040110394 NASA Langley Research Center, Hampton, VA, USA
Microstructural Characterization of Polymers with Positrons
Singh, Jag J.; [1997]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Positrons provide a versatile probe for monitoring microstructural features of molecular solids. In this paper, we report on positron lifetime measurements in two different types of polymers. The first group comprises polyacrylates processed on earth and in space. The second group includes fully-compatible and totally-incompatible Semi-Interpenetrating polymer networks of thermosetting and thermoplastic polyimides. On the basis of lifetime measurements, it is concluded that free volumes are a direct reflection of physical/electromagnetic properties of the host polymers.
Author
Microstructure; Positrons; Polymers; Permittivity; Electrostatics

20040110401 NASA Langley Research Center, Hampton, VA, USA
Fundamental Insight on Developing Low Dielectric Constant Polyimides
Simpson, J. O.; SaintClair, A. K.; [1997]; 19 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Thermally stable, durable, insulative polyimides are in great demand for the fabrication of microelectronic devices. In this investigation dielectric and optical properties have been studied for several series of aromatic polyimides. The effect of polarizability, fluorine content, and free volume on dielectric constant was examined. In general, minimizing polarizability, maximizing free volume and fluorination all lowered dielectric constants in the polyimides studied.
Author
Polyimides; Thermal Stability; Dielectric Properties; Fabrication

20040110482 Rockwell Scientific Co., LLC, Thousand Oaks, CA
High Temperature Studies of La-Monazite
Marshall, David; Davis, Janet B.; Jul. 2004; 103 pp.; In English
Report No.(s): AD-A425288; AFRL-SR-AR-TR-04-0387; No Copyright; Avail: CASI; A06, Hardcopy

This report summarizes results from a 3-year research effort aimed at gaining a basic understanding of high- temperature properties of LaP04, with a view to its application in high-temperature structural composites. Previous studies at Rockwell and the Air Force established that LaP04 has a unique set of properties that make it suitable as a weakly bonded interphase material that enables damage tolerance by decoupling damage in the matrix and the reinforcing fibers. However, there was previously very little information on the fundamental high temperature properties of LaP04, such as environmental stability, sintering, grain growth, mechanical and dielectric properties. Such studies require high purity powders that have only recently been produced at Rockwell. Using these materials, measurements have been made of the following properties: stability in various high temperature environments required for Air Force application, including water-containing environments typical of combustion, vacuum, and reducing environments; high- temperature creep, hardness, toughness, and sliding; low- temperature debonding, deformation, and sliding mechanisms; and dielectric properties. A preliminary assessment is made of the potential

for developing directionally solidified eutectic oxide 5 stems containing LaP04 for toughening. vv
DTIC
Composite Materials; High Temperature

20040110621 Savannah River Ecology Lab., Aiken, SC, USA
Melt Rate Improvement for DWPF MB3: Summary and Recommendations
Lambert, D. P.; Lorier, T. H.; Peeler, D. K.; Stone, M. E.; 2004; In English
Report No.(s): DE2004-783015; No Copyright; Avail: National Technical Information Service (NTIS)

The objective for this task is to understand and apply the control of glass batch chemistry (frit composition) and/or changes in chemical processing strategies to improve the overall melting process for Macrobatch 3 (MB3) (Defense Waste Processing Facility (DWPF) sludge-only processing). For melt rate limited systems, a small increase in melting efficiency translates into substantial savings by reducing operational costs without compromising the quality of the final waste product. This report summarizes the key information collected during the FY01 melt-rate testing completed to support the conclusion that switching from Frit 200, the frit currently used to prepare all the glass produced in radioactive processing, to Frit 320 should improve the melt rate during processing of DWPF MB3 sludge (Note: MB3 is referred to as Sludge Batch 2 in the High-Level Waste System Plan). The report also includes recommendations that should be addressed prior to implementation of the new frit and future research that should be completed to further improve melt rate. No analysis has been completed to determine if Frit 320 can be used in processing of other sludge macrobatches. The testing in this report is based on dried-slurry testing of a MB3 melter feed prepared from nonradioactive simulants. Additional testing, particularly with a melter feed slurry and actual waste, would be required before implementing the new frit in DWPF, and a variability study would also be necessary. The work to date, at most, provides relative data until actual melter data can be obtained and compared.
NTIS
Slurries; Radioactivity; Operating Costs; Melting; Glass

20040110624 Westinghouse Savannah River Co., Aiken, SC, USA, South Carolina State Univ., Orangeburg, SC, USA
Computer Modeling of a Glass Stream Departing from a Pour Spout Knife Edge
Guerrero, H. N.; Naseri-Neshat, H.; 2004; In English
Report No.(s): DE2004-4845; No Copyright; Avail: National Technical Information Service (NTIS)

Computer modeling of a liquid glass stream departing from a vertical cylindrical pour spout was performed using three different Computational Fluid Dynamics software packages. This flow belongs to a class of free surface flows that start as a film flow on a solid pour spout wall and then turns into a cylindrical jet as it departs from the pour spout knife-edge. Two-dimensional modeling investigated the effects of the liquid Property Parameter number, film Reynolds number, pour spout surface property, and pour spout geometry. Three-dimensional modeling was also performed for low and high flow cases. The analytical results are compared with experiments using glycerin, silicone oil, and molten glass.
NTIS
Computational Fluid Dynamics; Computerized Simulation; Glass; Cylindrical Bodies; Fluid Films

20040110723 NASA Langley Research Center, Hampton, VA, USA
Dielectric Properties of Piezoelectric Polyimides
Ounaies, Z.; Young, J. A.; Simpson, J. O.; Farmer, B. L.; [1997]; 6 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Molecular modeling and dielectric measurements are being used to identify mechanisms governing piezoelectric behavior in polyimides such as dipole orientation during poling, as well as degree of piezoelectricity achievable. Molecular modeling on polyimides containing pendant, polar nitrile (CN) groups has been completed to determine their remanent polarization. Experimental investigation of their dielectric properties evaluated as a function of temperature and frequency has substantiated numerical predictions. With this information in hand, we are then able to suggest changes in the molecular structures, which will then improve upon the piezoelectric response.
Author
Dielectric Properties; Piezoelectricity; Polyimides; Molecular Structure; Mathematical Models

20040110901 NASA Langley Research Center, Hampton, VA, USA
Polyimides Containing Fluorine and Phosphorus for Potential Space Applications
Connell, John W.; Watson, Kent A.; [2000]; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

As part of an effort to develop low color, ultraviolet (UV) radiation and atomic oxygen resistant polyimides for potential

space applications, a novel diamine containing fluorine and phosphorus was synthesized and used to prepare polyimides. The approach was to combine attributes from colorless, UV resistant polyimides and atomic oxygen (AO) resistant polymers into a single material. Preparation of colorless polyimides has focused on minimization of charge transfer complex formation by incorporation of bulky substituents and disrupting conjugation by using meta-catenated monomers. AO resistant polymer technology development has focused on placing phenylphosphine oxide groups into the backbone of aromatic polymers. However, polyimides prepared utilizing this approach thus far have all exhibited significant color. Thus in an attempt to combine these features in a polyimide a new diamine, bis(3-aminophenyl)-3,5-di(trifluoromethyl)phenylphosphine oxide (TFMDA) was synthesized and used to prepare polyimides. The polyimides were cast into films and characterized for physical and mechanical properties, optical transmission and AO and UV resistance.
Author
Phosphorus; Charge Transfer; Diamines; Fluorine; Oxides; Polyimides

20040111006 Defence Science and Technology Organisation, Fishermans Bend, Australia
A Health Assessment of Lubricating Oil in Two Australian Army CH47D Helicopters
Becker, Andrew; Rawson, Paul; July 2004; 49 pp.; In English
Report No.(s): DSTO-TR-1594; DODA-AR-013-133; Copyright; Avail: Other Sources

This report describes the findings of an investigation into the health of the lubricating oil in two Australian Army CH-47D helicopters. One of the aims of this investigation was to assess the applicability of an existing filter patch test kit for lubricating oil in order to provide basic contamination and wear debris information. The information provided by the filter patch test kit would be of particular benefit when aircraft are deployed to remote localities. The filter patch test kit used for this investigation is currently used by the Australian Defence Force to assess hydraulic fluid health. Another aim of this investigation was to assess a number of chemical and physical properties of the oils in order to obtain a better understanding of the condition of the oils in operational CH-47D helicopters. This investigation also examined whether certain aspects of the oil's chemical condition could be used to assess the health of the aircraft engines and transmissions.
Author
Aircraft Engines; Chemical Properties; Helicopters; Hydraulic Fluids; Lubricating Oils

20040111009 Prins Maurits Lab. TNO, Rijswijk, Netherlands
Trace Analysis of White Phosphorus in Seawater
Eerligh, R.; Ham, N. H. A.; Groeneveld, F. R.; February 2004; 23 pp.; In Dutch
Contract(s)/Grant(s): A/01D/4KA; TNO Proj. 014.13088
Report No.(s): TD-2002-0271; PML-2003-A97; Copyright; Avail: Other Sources

As TNO was not able to perform the chemical analysis of white phosphorus, two suitable analytical methods were chosen from the literature on this subject. These methods, based on an extraction or the use of a SPME fibre followed by gas chromatography, were tested in the laboratory. The detection limits of this methods were 0.01 ppb and 0.1 ppb. The methods was successfully applied in the analysis of seawater from the Oosterschelde.
Author
Chemical Analysis; Phosphorus; Extraction; Detection

28
PROPELLANTS AND FUELS

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

20040110484 Naval Postgraduate School, Monterey, CA
Turkey's Iran Card: Energy Cooperation in American and Russian Vortex
Dogan, Erkan; Jun. 2004; 117 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425292; No Copyright; Avail: CASI; A06, Hardcopy

This thesis analyzes the consequences of Turkey's natural gas cooperation with Iran. Two countries initiated cooperation in natural gas sales and transportation to Turkey and Europe. However, conflicting interests of many actors in energy issues make finding a solution harder. With the signing of the gas agreement between Turkey and Iran, the calculations became complicated even further. Turkey's efforts to industrialize its economy, Iran's struggle against the U.S. sanctions along with

its ideological reputation, the emergence of new independent former Soviet republics that are not very independent economically from Russia and the U.S. objectives in enhancing the political and economic advance of those republics as well as containment of Iran are the major issues on the scene. If a compromise that would address the needs and interests of all actors in the region could be reached, the regional political and economic stability could have a substantial contribution to global security and stability. In this sense, Turkey's natural gas cooperation with Iran plays an important role for future prospects, since it may distribute prosperity and stability through the pipelines established between two countries that can connect Central Asia to Europe.
DTIC
Iran; Natural Gas; Vortices

20040110684 NASA Langley Research Center, Hampton, VA, USA
An Investigation to Improve Quality Evaluations of Primers and Propellant for 20mm Munitions
Bement, L. J.; Holmes, C.; McGrory, J.; Schimmel, M. L.; [1997]; 30 pp.; In English; Munitions Technology Symposium IV, 10-12 Feb. 1997, Reno, NV, USA; No Copyright; Avail: CASI; A03, Hardcopy

To reduce the frequency of electrically initiated, 20mm munition hangfires (delayed ignitions), a joint Army/NASA investigation was conducted to recommend quality evaluation improvements for acceptance of both primers and gun propellant. This effort focused only on evaluating ignition and combustion performance as potential causes of hangfires: poor electrical initiation of the primer, low output performance of the primer, low ignition sensitivity of the gun propellant, and the effects of cold temperature. The goal was to determine the 'best' of the Army and NASA test methods to assess the functional performance of primers and gun propellants. The approach was to evaluate the performance of both high-quality and deliberately defective primers to challenge the sensitivity of test methods. In addition, the ignition sensitivity of different manufacturing batches of gun propellants was evaluated. The results of the investigation revealed that improvements can be made in functional evaluations that can assist in identifying and reducing ignition and performance variations. The 'best' functional evaluation of primers and propellant is achieved through a combination of both Army and NASA test methods. Incorporating the recommendations offered in this report may provide for considerable savings in reducing the number of cartridge firings, while significantly lowering the rejection rate of primer, propellant and cartridge lots. The most probable causes for ignition and combustion-related hangfires were the lack of calcium silicide in the primer mix, a low output performance of primers, and finally, poor ignition sensitivity of gun propellant. Cold temperatures further reduce propellant ignition sensitivity, as well as reducing burn rate and chamber pressures.
Author
Gun Propellants; Primers (Explosives); Firing (Igniting); Manufacturing; Ammunition

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*.

20040105521 NASA Langley Research Center, Hampton, VA, USA
Blunt Body Near-Wake Flow Field at Mach 10
Horvath, Thomas; Hannemann, Klaus; [1997]; 23 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Tests were conducted in a Mach 10 air flow to examine the reattachment process of a free shear layer associated with the near wake of a 70 deg half angle, spherically blunted cone having a cylindrical after body. The nominal free-stream Reynolds number based on model diameter ranged from 0.25 x l0(exp 6) to 1 x l0(exp 6) and the angle of incidence set at 0 and +/- 20 deg. The present study was designed to complement previously reported Mach 6 perfect air tests as well as results obtained in several hypervelocity facilities capable of producing real gas effects. Surface heating rates were inferred from temperature time histories from coaxial surface thermocouples on the model forebody and thin film resistance gages along the model base and cylindrical after body. Limited forebody, base, and support sting surface pressures were obtained with piezoresistive Experimental results are compared to laminar perfect gas predictions provided by a 3-0 Navier Stokes code (NSHYP). Shear layer impingement on the instrumented cylindrical after body resulted in a localized heating maximum that was 16 to 18percent of the forebody stagnation point and a factor of 2 higher than laminar predictions, suggesting a transitional or turbulent shear layer. transducers.
Author
Blunt Bodies; Near Wakes; Flow Distribution; Mach Number; Hypersonic Speed

20040110521 NTI, Inc., Brooks AFB, TX

The Sensitivity and Specificity of Oculometrics Under Fatigue Stress Compared to Performance and Subjective Measures

Miller, James C.; Eddy, Douglas R.; Fischer, Joseph; May 2004; 24 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-7757

Report No.(s): AD-A425455; AFRL-HE-BR-TR-2004-0056; No Copyright; Avail: CASI; A03, Hardcopy

We wished to compare the sensitivity of oculometric measures under fatigue stress to the sensitivities of performance and subjective measures, and to assess the specificity of oculometrics for predicting performance effects. We used data from the first night of sleep deprivation in a sleep aids study. Each of 13 subjects was represented four times in the final data set, with each of these four nights separated by at least a week. We focused on oculometric, simple cognitive task and subjective data and on two test periods within the night of sleep deprivation: at 21:00 and 03: 00. All data were standardized as within-subject z scores across weeks. There were large, reliable differences in cognitive task performance and subjective assessments, in the expected directions, across the two measurement periods. There were smaller, less reliable differences in three of the four ocular measures, in the expected directions, across the two periods. We attempted to use hierarchical stepwise multiple linear regression as a first step in assessing the specificity of the three sensitive ocular measures for predicting the effects of the fatigue manipulation on cognitive performance. We selected simple response time and simple cognitive processing throughput as targets for prediction. Our strategy was to use the first 3 weeks of data to develop the regression equations, and then the last week of data for an assessment of specificity. The fatigue-related changes (from 21:00 to 03:00) in the three ocular measures were such poor predictors of the changes in logical reasoning throughput and simple response speed that we were unable to proceed with the specificity analysis. Overall, we were able to conclude that the individual ocular measures were less sensitive than the performance and subjective measures to this particular fatigue manipulation.

DTIC

Fracture Mechanics; Oculometers; Sensitivity

20040110903 University Coll., London, UK

Modelling Spots: The Calmed Region, Pressure Gradient Effects and Background

Smith, Frank T.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 447-453; In English; See also 20040110902; No Copyright; Avail: CASI; A02, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This ongoing work is aimed at the understanding and modelling/analysis of spots from a first-principles basis within either a laminar or a turbulent layer. This continues previous studies by the author's group and addresses in particular attempts at theoretical modelling of: (1) the calmed region, (2) the effects of pressure gradient , and (3) a spot within a turbulent layer. The development of spots initially localised and at low or high amplitudes is to be described. In (1), an inviscid model of the laminar 'calmed region' following a 3D turbulent spot within a transitioning 2D layer is formulated. Products of small fluctuations force a perturbation to the mean flow, especially to the surface streamlines. Available experimental evidence shows a fuller more stable streamwise profile in a considerable region trailing the spot, with cross-flow in-wash towards the line of symmetry. Present results are in qualitative agreement with this evidence. (2) is on the evolution of a spot within a simplified boundary layer form which models pressure gradient effects. A favourable gradient makes the spot split into two parts, overlapping at first but then moving along in tandem. An adverse gradient instead splits the spot into two non-overlapping regions between which a strong sub-spot develops, full of exponentially growing fluctuations. Comparisons with experiments are made, of the spot spread angle under various pressure gradients, and these prove to be fairly close. (3). The above theory and computation is for laminar incompressible flow but is extendable to turbulent and compressible spots also. Some progress on the latter has been reported previously. On the former, the turbulent case is attempted by means of a mixing length model for unsteady flow. Nonlinear three-dimensional spots are tracked with a view to understanding their long-term behaviour. The influences of disturbance size and Reynolds number are among the other main features. Allied recent work is on the effects of vortical wake passing as an initiator, followed by nonlinear evolution, nonparallel flow evolution and related three-dimensional responses. Wakes with an in-parallel arrangement, modelling the wakes from a row of quasi-rotor blades upstream which are vertically periodic but moving downward, could also be discussed.

Derived from text

Mathematical Models; Wakes; Unsteady Flow; Turbulence; Pressure Effects; Incompressible Flow

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*.

20040105581 NASA Goddard Space Flight Center, Greenbelt, MD, USA
An Architecture to Enable Future Sensor Webs
Mandl, Dan; Caffrey, Robert; Frye, Stu; Grosvenor, Sandra; Hess, Melissa; Chien, Steve; Sherwood, Rob; Davies, Ashley; Hayden, Sandra; Sweet, Adam, et al.; [2004]; 18 pp.; In English; Space Ops 2004, 17-21 May 2004, Montreal, Canada; Copyright; Avail: CASI; A03, Hardcopy

A sensor web is a coherent set of distributed 'nodes', interconnected by a communications fabric, that collectively behave as a single dynamic observing system. A 'plug and play' mission architecture enables progressive mission autonomy and rapid assembly and thereby enables sensor webs. This viewgraph presentation addresses: Target mission messaging architecture; Strategy to establish architecture; Progressive autonomy with onboard sensor web; EO-1; Adaptive array antennas (smart antennas) for satellite ground stations.
Derived from text
Satellite Communication; Communication Networks; Architecture (Computers)

20040105652 NASA Langley Research Center, Hampton, VA, USA
Satellite Systems Design/Simulation Environment: A Systems Approach to Pre-Phase A Design
Ferebee, Melvin J., Jr.; Troutman, Patrick A.; Monell, Donald W.; [1997]; 11 pp.; In English; 34th AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 1997, Reno, NV, USA
Report No.(s): AIAA Paper 97-0231; Copyright; Avail: CASI; A03, Hardcopy

A toolset for the rapid development of small satellite systems has been created. The objective of this tool is to support the definition of spacecraft mission concepts to satisfy a given set of mission and instrument requirements. The objective of this report is to provide an introduction to understanding and using the SMALLSAT Model. SMALLSAT is a computer-aided Phase A design and technology evaluation tool for small satellites. SMALLSAT enables satellite designers, mission planners, and technology program managers to observe the likely consequences of their decisions in terms of satellite configuration, non-recurring and recurring cost, and mission life cycle costs and availability statistics. It was developed by Princeton Synergetic, Inc. and User Systems, Inc. as a revision of the previous TECHSAT Phase A design tool, which modeled medium-sized Earth observation satellites. Both TECHSAT and SMALLSAT were developed for NASA.
Derived from text
Mission Planning; Simulation; Systems Engineering; Satellite Configurations

20040110393 NASA Langley Research Center, Hampton, VA, USA
Analysis of Stub Loaded Microstrip Patch Antennas
Deshpande, M. D.; Bailey, M. C.; [1997]; 4 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

A microstrip patch antenna fed by a coaxial probe and reactively loaded by a open circuited microstrip line has been used previously to produce circular polarization and also as a building block for a series fed microstrip patch array. Rectangular and circular patch antennas loaded with a microstrip stub were previously analyzed using the generalized Thevenin theorem. In the Thevenin theorem approach, the mutual coupling between the patch current and the surface current on the stub was not taken into account. Also, the Thevenin theorem approach neglects continuity of current at the patch-stub junction. The approach in this present paper includes the coupling between the patch and stub currents as well as continuity at the patch-stub junction. The input impedance for a stub loaded microstrip patch is calculated by the general planar dielectric dyadic Green's function approach in the spectral domain, as was initiated much earlier and has been extensively expanded upon and utilized successfully throughout the literature for microstrip antenna configurations. Using the spectral domain dyadic Green s function derived earlier with the electric field integral equation (EFIE), the problem is formulated by using entire domain basis functions to represent the surface current densities on the patch, the loading stub and the attachment mode at the junction. Galerkin's procedure is used to reduce the EFIE to a matrix equation, which is then solved to obtain the amplitudes of the surface currents. These surface currents are then used for calculating the input impedance of stub loaded rectangular and

circular microstrip patches. Numerical results are compared with measured results and with previous results calculated by the Thevenin's theorem approach.
Derived from text
Patch Antennas; Loads (Forces); Numerical Analysis; Coupling; Microstrip Antennas

20040110430 NASA Langley Research Center, Hampton, VA, USA
Radiation Characteristics of Cavity Backed Aperture Antennas in Finite Ground Plane Using the Hybrid FEM/MoM Technique and Geometrical Theory of Diffraction
Reddy, C. J.; Deshpande, M. D.; Cockrell, C. R.; Beck, F. B.; [1996]; 26 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

A technique using hybrid Finite Element Method (FEM)/Method of Moments (MoM), and Geometrical Theory of Diffraction (GTD) is presented to analyze the radiation characteristics of cavity fed aperture antennas in a finite ground plane. The cavity which excites the aperture is assumed to be fed by a cylindrical transmission line. The electromagnetic (EM) fields inside the cavity are obtained using FEM. The EM fields and their normal derivatives required for FEM solution are obtained using (1) the modal expansion in the feed region and (2) the MoM for the radiating aperture region(assuming an infinite ground plane). The finiteness of the ground plane is taken into account using GTD. The input admittance of open ended circular, rectangular, and coaxial line radiating into free space through an infinite ground plane are computed and compared with earlier published results. Radiation characteristics of a coaxial cavity fed circular aperture in a finite rectangular ground plane are verified with experimental results.
Author
Apertures; Cavities; Finite Element Method; Geometrical Theory of Diffraction; Method of Moments; Antenna Radiation Patterns

20040110465 Defence Science Technology Lab., Malvern
Attrition in Network Centric Warfare
Erbetta, John; Dec. 2003; 17 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425258; No Copyright; Avail: CASI; A03, Hardcopy

Network Centric Warfare (NCW) is concerned with exploiting information to maximize combat power. Integration of C2 systems is able to increase military effectiveness, whether in maneuver, engagement, logistics, or protection. However, this increases the potential length of the electronic chain from sensor to shooter. This paper acknowledges that battle damage and force attrition (both equipment and human) occur in real conflict. The hypothesis is that at some point this may result in decreased force effectiveness rather than increased advantage. Information warfare means that positive attacks on systems themselves compound the problem. Emerging technologies applicable to NCW as a force multiplier need to be recognized as counter to the impediments to progress in the development of NCW. The impact of battle damage, attrition, and cyber attack is addressed as well as system security and the associated human factors of authority and responsibility. Options to minimize these vulnerabilities are postulated. The development of distributed systems and the potential of using arbitration in decision making is viewed as one way to minimize the impact of performance on C2 effectiveness. The paper also recognizes that while dominance (in its widest sense) is the ambition of symmetric warfare, in the asymmetric case structures can be undermined by relatively unsophisticated attack. In particular, the paper's purpose is to underline the fact that implementations need to ensure that attrition results in graceful, rather than catastrophic, degradation. At the extreme end of the C2 performance spectrum the following question must be asked: To what extent can degraded C2 performance threaten force effectiveness? Assessment at this level is difficult and real answers are only likely to come from real-life exercises that study the degree of reliance on C2 effectiveness during battle. The output will indicate that steps that need to be taken. (8 briefing charts, 6 refs.)
DTIC
Combat; Command and Control; Damage; Vulnerability; Warfare

20040110488 Department of the Air Force, Arlington, VA
Analysis of Effects-Based Operations - The Road Ahead to Doing Business Differently
Uchida, Ted T.; Dec. 2003; 30 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425307; No Copyright; Avail: CASI; A03, Hardcopy

Currently, a significant amount of discussion in the USA Air Force centers on Effects-Based Operations (EBO) as the new way to fight. This debate ranges from Military Operations Research Society (MORS) workshops sponsored by senior civilian and military leaders to articles and booklets written by USAF general officers. This paper will provide a definition and brief

discussion of EBO before focusing on its main area EBO Wargaming, Experimentation, and Exercises. The EBO in Wargaming, Experimentation, and Exercises section of the will address EBO as a concept and process and finally a concept of operations (CONOPS). In addition, it will explore an experimentation strategy for determining the 'good' and 'bad' aspects of EBO and how to logically progress from Wargames through Experiments to Exercises. In an effort to map the road ahead for analysis of EBO, the paper will address four questions: 1) How are Effect- Based Operations currently analyzed and/or characterized in wargames, experiments, and exercises? 2) What are the indicators of success for Effects-Based Operations in wargames, experiments, and exercises? 3) What tools and techniques are available to analyze and measure the indicators of success and do any shortfalls exist in this set of tools and techniques? 4) What can be done to improve the analysts of Effects-Based Operations? This paper will conclude by highlighting on-going efforts to incorporate and implement Effects-Based Operations in future wargames, experiments, and excises and potential impacts on doctrine, organization, training, and leadership.
DTIC
Commerce; Military Operations; Operations Research; Roads; War Games

20040110490 Air Command and Staff Coll., Maxwell AFB, AL
Coup D'Oeil or Confusion: An Assessment of the Common Operational Picture
Stanko, Joseph J.; Apr. 1999; 77 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425312; AU/ACSC/200/1999-04; No Copyright; Avail: CASI; A05, Hardcopy

The Common Operational Picture (COP) is an automated command, control, communications, computer, and intelligence (C4I) system providing enhanced viewing of friendly and enemy forces by users of the Global Command and Control System (GCCS). Capabilities include collection of real- time and near-real-time data from multiple sources, data fusion and the capability to present information as a common geographic display. This research effort looks at history, doctrine, technology, and interview responses, and concludes the GCCS COP is more coup d' oeil than confusion, providing a useful capability to commanders in theater. However, as with all emerging systems, there is still much work to be done to fully meet the needs of, and have the system fully used by the warfighter. This paper also presents a GCCS COP 'report card,' with criteria derived from history and doctrine, for possible use in future evaluations.
DTIC
Command and Control; Images

20040110640 Lawrence Livermore National Lab., Livermore, CA
Detecting Antipersonnel Mines with a Handheld Parabolic Reflector Transmitter/Multistatic Receiver Impulse GPR
Rappaport, C.; Yang, B.; Azevedo, S.; Rosenbury, T.; Gough, J.; Apr. 10, 2000; 14 pp.; In English
Report No.(s): DE2004-15007531; UCRL-JC-139547; No Copyright; Avail: Department of Energy Information Bridge

A novel handheld time-domain array GPR antipersonnel mine detection system using an offset paraboloidal reflector antenna is described. The reflector collimates rays from an ultra-wideband transmitting feed, directing the microwave impulse forward, in front of the antenna structure. As such, much of the ground reflected wave is directed further forward, away from the operator, the reflector, and the receiving antennas, and thereby reducing the major source of clutter. The wave transmitted into the ground that interacts with the target, generating significant backscatter returning toward the receiving antennas. These receiving antennas are configured in a 2 by 2 array to provide spatial focusing in both the along- and cross-track directions. This system has been built and tested at both Lawrence Livermore National Laboratory, and GeoCenters, Inc. In both cases, custom-built wideband antenna elements generate narrow pulse shapes, which allow for resolving small non-metallic targets buried at shallow depths.
NTIS
Detection; Antenna Components; Mine Detectors

20040110707 National Academy of Sciences - National Research Council, Washington, DC, USA
Safe Drinking Water Hotline. Fiscal Year 2003, Annual Report
Sep. 2003; In English
Report No.(s): PB2004-107066; No Copyright; Avail: National Technical Information Service (NTIS)

The Safe Drinking Water Act (SDWA) is the national law that ensures the quality of America's drinking water and furthers EPAs mission to protect human health and safeguard the environment. The Act, as amended in 1996, requires the U.S. Environmental Protection Agency (EPA) to provide a toll-free hotline that consumers can call to obtain accurate and real-time information about annual water quality reports and drinking water contaminants (42 U.S.C. 300g-3, Section (4)(A) and

(4)(B)). The Safe Drinking Water (SDW) Hotline, operated by Booz Allen Hamilton, provides this essential public outreach service for EPA's Office of Ground Water and Drinking Water (OGWDW), the office that is responsible for implementing the SDWA. The Hotline also answers questions about federal drinking water regulations and standards, source water protection, and the Underground Injection Control (UIC) program. In fiscal year 2003 (FY 2003), the Hotline responded to 21,602 phone calls and 3,304 e-mail inquiries resulting in more than 31,351 questions. This is the annual report for 2003.
NTIS
Potable Water; Environment Protection; Ground Water

20040111003 Defence Science and Technology Organisation, Edinburgh, Australia
Enabling Headquarters Reachback : Adaptation of Collaborative Applications for Tenuous Communications
Au, T. Andrew; Tran, Cindy; June 2004; 37 pp.; In English
Report No.(s): DSTO-TR-1588; DODA-AR-013-122; Copyright; Avail: Other Sources

The ability to access information on demand is a critical capability in the battlefield. Deployed military headquarters are often located in a challenging tactical environment, whereby major disruptions to collaborative work lead to an impairment in the operation capability. These challenges in turn stem mainly from volatile connectivity and sporadic network mobility, which are a feature of the unpredictable nature of the battlefield. A network management approach based entirely on resource reservation is especially difficult in this environment since disturbances and unanticipated events often occur with network-based applications. This paper explores the concept of network awareness in support of continued operation in an unpredictable battlefield environment. In particular, we propose a platform-independent event-delivery framework to facilitate application adaptation, and demonstrate the advantages of this approach in supporting the proactive management of applications.
Author
Information Transfer; Deployment

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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*.

20040100725 Georgia Tech Research Inst., Atlanta, GA, USA
Application of a Device for Uniform Web Drying and Preheating Using Microwave Energy
Ahrens, F. W.; Sep. 2003; In English
Report No.(s): DE2003-816299; No Copyright; Avail: National Technical Information Service (NTIS)

The project summarized in this report dealt with an evaluation of new microwave applicator ideas for paper preheating and drying. The technical basis for success in this project is the fact that Industrial Microwave Systems has recently identified certain previously unrecognized wave guide 'design variables' and hardware implementation concepts that can be employed to greatly improve the uniformity of microwave energy distribution for continuous flow processes. Two applicator concepts were ultimately evaluated, a Cross-Machine Direction (CD) oriented applicator and a Machine Direction (MD) oriented applicator. The economic basis for success is the result of several factors. Since 1985, the capital expenditure required for an industrial microwave applicator system has decreased by a factor of four. The maintenance costs have decreased by a factor of 10 and the life expectancy of the magnetron has increased by more than a factor of four to in excess of 8,000 hours (nearly one year at 24 hours/day operation).
NTIS
Microwave Equipment; Continuum Flow; Maintenance; Magnetrons

20040110474 Scripps Institution of Oceanography, La Jolla, CA
Estimating Source Depth from Broadband Striations in Single Element and Towed Array Spectrograms
Kuperman, William A.; D'Spain, Gerald; Jan. 2002; 9 pp.; In English
Contract(s)/Grant(s): N00014-01-D-0043-DO#2
Report No.(s): AD-A425278; No Copyright; Avail: CASI; A02, Hardcopy

The objectives of this program were to develop and test new signal processing algorithms based on waveguide invariants

for use in three challenging ocean acoustic scenarios: 1) range-dependent environments, 2) signals with low signal-to-noise ratio (SNR), and 3) acoustically cluttered conditions.
DTIC
Broadband; Depth; Estimating; Shallow Water; Signal Processing; Signal to Noise Ratios; Spectrograms; Striation

20040110486 Industrial Coll. of the Armed Forces, Washington, DC
AY 2002-2003 Industry Study: Final Report Strategic Materials
Adams, Karen S.; Bennett, John R.; Coutteau, Charles G.; Edge, James E.; Flanery, Rose S.; Jan. 2003; 41 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425297; No Copyright; Avail: CASI; A03, Hardcopy

Strategic materials are those materials, along with research, development, and technology that are critical in ensuring a US competitive advantage, both economically and with respect to national security capabilities. Emerging innovative material technologies are those enabling greater levels of designed-in properties, functionality, and application, as well as the creation of fundamentally new materials. Technological innovations in materials science affect many of the elements of national power. Ultimately, strategic materials are critical transformation enablers for our society, economy, and national security.
DTIC
Industries; Military Technology; Phase Transformations; Security; Strategic Materials

20040110503 Scripps Institution of Oceanography, La Jolla, CA
Forward Scattering Experiment
Hodgkiss, William S.; Jun. 2002; 4 pp.; In English
Contract(s)/Grant(s): N00014-97-D-0350-D07
Report No.(s): AD-A425357; No Copyright; Avail: CASI; A01, Hardcopy

The objective of this project was to participate in the planning and carrying out of a forward scattering experiment including the deployment of a vertical array of source transducers. Unfortunately, due to several changes of candidate locations and dates for the experiment, this project ended without the experiment actually having been carried out.
DTIC
Forward Scattering

20040110511
Coated and Uncoated Models; What is the Difference? Part 2: Cavity Resonances
Maidanik, G.; Becker, K. J.; Maga, L. J.; Aug. 2004; 70 pp.; In English
Report No.(s): AD-A425384; NSWCCD-70-TR-2004/115; No Copyright; Avail: CASI; A04, Hardcopy

The rudimentary model of Part I is elaborated by introducing a baffle below the equivalent plate. In the cavity that forms, between the equivalent plate and the baffle, fluid is introduced. The cavity induces resonances and anti- resonances in the response of the equivalent plate. In turn, these resonances and anti-resonances imprint their presence on the regular transfer functions. These imprints are modulated by the resonance between the surface mass impedance of the equivalent plate and the surface stiffness (compliance) impedance of the coating when the coating is present. In the absence of coating, this modulation is also absent, although the imprints of the resonances and anti-resonances in the transfer functions persist. The influence of the coating, on the imprints of the cavity resonances and anti-resonances, is isolated by presenting the ratio of the transfer function in the presence of coating to that in absence of coating. The transfer functions and their ratios are computed as functions of the normalized frequency. Variations on the theme, in which parameters are changed from standard values, are examined and displayed. In particular, the major hump and minor dump emerge in these displays. Since resonances (and anti-resonances) are sensitive to damping, a number of types and degrees of damping are examined and assessed for effectiveness as noise control agents.
DTIC
Cavity Resonators; Coatings

20040110514 Mission Research Corp., Santa Barbara, CA
Simulation of a 35 GHz Klystron Using a Magic2D Template
Ludeking, Lars D.; May 2003; 25 pp.; In English
Contract(s)/Grant(s): F49620-00-C-0012
Report No.(s): AD-A425402; MRC00005Z; AFRL-SR-AR-TR-04-0394; No Copyright; Avail: CASI; A03, Hardcopy

This final report includes a copy of the electronic Magic User's Manual. The Manual illustrates the basic concepts of EM-PIC and introduces the concepts necessary for application to a variety of VEC and PLASMA processes. In addition, it contains numerous examples illustrating the techniques for%matching laboratory and engineering measurements to equivalent simulation modeling measurements. There are several seminar presentations (PPT documents plus input files) designed to introduce specific engineering and vacuum electronic concepts in a comprehensive and intuitive fashion. These presentations summarize many of the research activities with specific examples that we have been involved in during the period of performance. They provide a record of the sophisticated techniques developed for obtaining quantitative and predictive results from simulations that are equivalent to laboratory measurements. Finally, a copy of the low power 35 GHZ, klystron amplifier template developed in collaboration with SLAC is included. The report provides a step-by-step approach to evaluation of the klystron design as well as providing the opportunity to modify this design and compare the results.
DTIC
Klystrons; Plasmas (Physics); Simulation; Templates

20040110559 Department of the Navy, Washington, DC
Apparatus and Method for Calibrating Voltage Spike Waveforms for Three-Phase Electrical Devices and Systems
Muhitch, Joseph M., Inventor; Aug. 26, 2003; 28 pp.; In English
Patent Info.: Filed 26 Aug. 2003; US-Patent-Appl-SN-10652078
Report No.(s): AD-D020136; No Copyright; Avail: Defense Technical Information Center (DTIC)

This patent application discloses an apparatus and method for calibrating three-phase voltage spike waveforms used in testing three-phase electrical devices. The apparatus includes a circuit having a plurality of phase voltage lines and a ground line. Phase voltage outputs and a ground output are provided for connection to a device under test. A selection circuit selects one of the phase voltage lines and provides a synchronization voltage signal based on the other lines. A voltage spike generator is joined to the selection circuit for generating a voltage spike waveform synchronized with the voltage signal. Additional circuitry is joined to the voltage spike generator, the phase voltage lines, and the outputs, which applies the voltage spike waveform across the selected phase voltage line and the ground line. (4 tables, 3 figures)
DTIC
Calibrating; Compatibility; Electric Equipment; Electric Potential; Patent Applications; Waveforms

20040110560 Limerick Univ., Limerick, Ireland
Development of a Robust Smart Antenna Array Signal- Processing Algorithmbased on Antenna Array Auto-Calibration Using GPS Signals
O'Droma, M.; Nov. 2002; 76 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F73001-F30602-99MV072
Report No.(s): AD-A425265; SPC-01-4075; No Copyright; Avail: CASI; A05, Hardcopy

For the U.S. Air Force better, more rapid decision- making is essential to achieving virtually all joint war- fighting capabilities in the 21st century battle-space. War- fighters must be assured the capability to seamlessly acquire, store, distribute and protect their information. Seamless communications span the globe; interconnecting command echelons, services, and allies worldwide by implementing common transport protocols and dynamic network management. By focusing on wide bandwidth capabilities linked to the Air Force's current narrowband tactical systems, including mitigated modems to recover messages during nuclear and naturally disturbed environments, the Air Force can provide the correct critical information to the warrior anywhere in the world. To achieve wideband seamless communications it is essential to use smart conformal wideband (2 MHz 2 GHz) antennas. This has the added benefit of resulting in fewer antennas being required on airplanes and Uninhabited Air Vehicles (UAVs). The University of Limerick has ongoing research in the general area of array signal processing algorithms for smart antennas. The principal general goal of this project is the development of improved robust, stable and accurate algorithms for signal source bearing estimations using sampled data taken from the sensors of phase array antennas on airplanes and UAVs. The particular goal is to investigate the feasibility of using Global Positioning System (GPS) signals to facilitate 'on-the-fly' auto-calibration of phase array antennas and to develop a means of doing so.
DTIC
Algorithms; Antenna Arrays; Calibrating; Global Positioning System; Phased Arrays; Signal Processing

20040110758 Lawrence Livermore National Lab., Livermore, CA
Mechanical Engineering Safety Note Analysis and Control of Hazards Associated with NIF Capacitor Module Events
Brereton, S.; Aug. 01, 2001; In English
Report No.(s): DE2004-15007228; UCRL-ID-145413; No Copyright; Avail: National Technical Information Service (NTIS)

The NIF capacitor module was reviewed with respect to pressure venting and shrapnel containment during failures. A modified module concept was proposed that would adequately vent the pressure, yet be effective at containing shrapnel. Two large vents are provided on each side of the module. These have fixed vent areas, and are immediately accessible for pressure venting at the beginning of a pressure transient. A shrapnel shield is located on the outside of each vent opening forming a chute. The chute contains a collimator. This increases the number of bounces that shrapnel must take on the way out, and directs the shrapnel to the trap beneath. The trap contains a depth of clear pine, sufficient to completely absorb the energy of even the most energetic fragment considered.
NTIS
Capacitors; Collimators; Hazards; Control

20040110834 NASA Glenn Research Center, Cleveland, OH, USA
Spiral Chip Implantable Radiator and Printed Loop External Receptor for RF Telemetry in Bio-Sensor Systems
Simons, Rainee N.; Hall, David G.; Miranda, Felix A.; [2004]; 12 pp.; In English; Radio and Wireless Conference (RAWCON 2004), 19-22 Sep. 2004, Atlanta, GA, USA
Contract(s)/Grant(s): WBS 22-251-30-15
Report No.(s): NASA/TM-2004-213217; T3A-5; E-14501; No Copyright; Avail: CASI; A03, Hardcopy

The paper describes the operation of a patented wireless RF telemetry system, consisting of a bio-MEMS implantable sensor and an external hand held unit, operating over the frequency range of few hundreds of MHz. A MEMS capacitive pressure sensor integrated with a miniature inductor/antenna together constitute the implantable sensor. Signal processing circuits collocated with a printed loop antenna together form the hand held unit, capable of inductively powering and also receiving the telemetry signals from the sensor. The paper in addition, demonstrates a technique to enhance the quality factor and inductance of the inductor in the presence of a lower ground plane and also presents the radiation characteristics of the loop antenna.
Author
Pressure Sensors; Radio Frequencies; Signal Processing; Microelectromechanical Systems; Implantation; Chips

20040110972 Georgia Inst. of Tech., Atlanta, GA, USA
Project: Micromachined High-Frequency Circuits For Sub-mm-wave Sensors
Papapolymerou, Ioannis John; September 13, 2004; 4 pp.; In English
Contract(s)/Grant(s): NCC3-900; Copyright; Avail: Other Sources

A novel micromachined resonator at 45 GHz based on a defect in a periodic electromagnetic bandgap structure (EBG) and a two-pole Tchebysbev filter with 1.4% 0.15 dB equiripple bandwidth and 2.3 dB loss employing this resonator are presented in this letter. The periodic bandgap structure is realized on a 400 micron thick high-resistivity silicon wafer using deep reactive ion etching techniques. The resonator and filter can be accessed via coplanar waveguide feeds.
Author
Sensors; Submillimeter Waves; Micromachining; High Frequencies; Circuits; Fabrication; Electromagnetism

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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*.

20040095920 NASA Langley Research Center, Hampton, VA, USA
The Application of Nonstandard Analysis to the Study of Inviscid Shock Wave Jump Conditions
Farassat, F.; Baty, R. S.; [1998]; 17 pp.; In English; 51st Annual Meeting of APS Division of Fluid Mechanics, 22-24 Nov. 1998, Philadelphia, PA, USA; No Copyright; Avail: CASI; A03, Hardcopy

The use of conservation laws in nonconservative form for deriving shock jump conditions by Schwartz distribution theory leads to ambiguous products of generalized functions. Nonstandard analysis is used to define a class of Heaviside functions where the jump from zero to one occurs on an infinitesimal interval. These Heaviside functions differ by their microstructure near x = 0, i.e., by the nature of the rise within the infinitesimal interval it is shown that the conservation laws in nonconservative form can relate the different Heaviside functions used to define jumps in different flow parameters. There are no mathematical or logical ambiguities in the derivation of the jump conditions. An important result is that the microstructure of the Heaviside function of the jump in entropy has a positive peak greater than one within the infinitesimal interval where

the jump occurs. This phenomena is known from more sophisticated studies of the structure of shock waves using viscous fluid assumption. However, the present analysis is simpler and more direct.
Author
Shock Waves; Conservation Laws; Flow Characteristics

20040095945 NASA Langley Research Center, Hampton, VA, USA
A Parametric Study of Jet Interactions with Rarefied Flow
Glass, C. E.; [2004]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Three-dimensional computational techniques, in particular the uncoupled CFD-DSMC of the present study, are available to be applied to problems such as jet interactions with variable density regions ranging from a continuum jet to a rarefied free stream. When the value of the jet to free stream momentum flux ratio approximately greater than 2000 for a sharp leading edge flat plate forward separation vortices induced by the jet interaction are present near the surface. Also as the free stream number density n (infinity) decreases, the extent and magnitude of normalized pressure increases and moves upstream of the nozzle exit. Thus for the flat plate model the effect of decreasing n (infinity) is to change the sign of the moment caused by the jet interaction on the flat plate surface.
Derived from text
Computational Fluid Dynamics; Jet Flow; Rarefied Gas Dynamics; Three Dimensional Flow; Flow Distribution

20040100690 Environmental Protection Agency, Research Triangle Park, NC, Fluent, Inc., Lebanon, NH, USA
Development and Applications of CFD (Computational Fluid Dynamics) Simulations in Support of Air Quality Studies Involving Buildings
Huber, A.; Tang, W.; Bell, B.; Kuehlert, K.; Flowe, A.; 2004; In English
Report No.(s): PB2004-106738; EPA/600/A-04/078; No Copyright; Avail: National Technical Information Service (NTIS)

There is a need to properly develop the application of Computational Fluid Dynamics (CFD) methods in support of air quality studies involving pollution sources near buildings at industrial sites. CFD models are emerging as a promising technology for such assessments, in part due to the advancing power of computational hardware and software. CFD simulations have the potential to yield more accurate solutions than other methodologies because they are a solution of the fundamental physics equations and includes the effects of detailed three-dimensional geometry and local environmental conditions. However, the tools are not well validated for environmental flows and best-practice methodologies have not been established. Fluent Incorpation and the US EPA National Exposure Research Laboratory are working cooperatively to demonstrate CFD model simulations as a proven and applied tool in support of environmental assessment studies.
NTIS
Air Quality; Buildings

20040100740 Tulsa Univ., OK, USA
Advanced Cuttings Transport Study
Reed, T.; Miska, S.; Takach, N.; Ashenayi, K.; Volk, L.; Oct. 2002; In English
Report No.(s): DE2003-819258; No Copyright; Avail: National Technical Information Service (NTIS)

No abstract available
Data Collection Platforms; Transport Vehicles

20040100811 NASA Langley Research Center, Hampton, VA, USA
Hypersonic Flow Computations on Unstructured Meshes
Bibb, K. L.; Riley, C. J.; Peraire, J.; [1997]; 12 pp.; In English
Contract(s)/Grant(s): NAG1-1587
Report No.(s): AIAA Paper 97-0625; Copyright; Avail: CASI; A03, Hardcopy

A method for computing inviscid hypersonic flow over complex configurations using unstructured meshes is presented. The unstructured grid solver uses an edge{based finite{volume formulation. Fluxes are computed using a flux vector splitting scheme that is capable of representing constant enthalpy solutions. Second{order accuracy in smooth flow regions is obtained by linearly reconstructing the solution, and stability near discontinuities is maintained by locally forcing the scheme to reduce to first-order accuracy. The implementation of the algorithm to parallel computers is described. Computations using the proposed method are presented for a sphere-cone configuration at Mach numbers of 5.25 and 10.6, and a complex hypersonic re-entry vehicle at Mach numbers of 4.5 and 9.8. Results are compared to experimental data and computations made with

established structured grid methods. The use of the solver as a screening tool for rapid aerodynamic assessment of proposed vehicles is described.
Author
Hypersonic Flow; Computational Fluid Dynamics; Unstructured Grids (Mathematics); Flux Vector Splitting

20040100815 NASA Langley Research Center, Hampton, VA, USA
Large-Eddy Simulation of Laminar-Turbulent Transition in a Swept-Wing Boundary Layer
Huai, X.; Joslin, R. D.; Piomelli, U.; January 2004; 12 pp.; In English
Contract(s)/Grant(s): NAG1-1089
Report No.(s): AIAA Paper 97-0750; Copyright; Avail: CASI; A03, Hardcopy

A continuous adjoint approach for obtaining sensitivity derivatives on unstructured grids is developed and analyzed. The derivation of the costate equations is presented, and a second-order accurate discretization method is described. The relationship between the continuous formulation and a discrete formulation is explored for inviscid, as well as for viscous flow. Several limitations in a strict adherence to the continuous approach are uncovered, and an approach that circumvents these difficulties is presented. The issue of grid sensitivities, which do not arise naturally in the continuous formulation, is investigated and is observed to be of importance when dealing with geometric singularities. A method is described for modifying inviscid and viscous meshes during the design cycle to accommodate changes in the surface shape. The accuracy of the sensitivity derivatives is established by comparing with finite-difference gradients and several design examples are presented.
Author
Aerodynamic Stability; Design Optimization; Unstructured Grids (Mathematics); Large Eddy Simulation

20040105519 NASA Langley Research Center, Hampton, VA, USA
Static Aeroelastic Analysis of Transonic Wind Tunnel Models Using Finite Element Methods
Hooker, John R.; Burner, Alpheus W.; Valla, Robert; [1997]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

A computational method for accurately predicting the static aeroelastic deformations of typical transonic transport wind tunnel models is described. The method utilizes a finite element method (FEM) for predicting the deformations. Extensive calibration/validation of this method was carried out using a novel wind-off wind tunnel model static loading experiment and wind-on optical wing twist measurements obtained during a recent wind tunnel test in the National Transonic Facility (NTF) at NASA LaRC. Further validations were carried out using a Navier-Stokes computational fluid dynamics (CFD) flow solver to calculate wing pressure distributions about several aeroelastically deformed wings and comparing these predictions with NTF experimental data. Results from this aeroelastic deformation method are in good overall agreement with experimentally measured values. Including the predicted deformations significantly improves the correlation between CFD predicted and experimentally measured wing & pressures.
Author
Aeroelasticity; Transonic Wind Tunnels; Wind Tunnel Models; Finite Element Method

20040105525 NASA Ames Research Center, Moffett Field, CA, USA
Numerical Simulation of Turbulent MHD Flows Using an Iterative PNS Algorithm
Kato, Hiromasa; Tannehill, John C.; Mehta, Unmeel B.; [2003]; 12 pp.; In English; 41st AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA
Contract(s)/Grant(s): NCC2-5379; NCC2-5517
Report No.(s): AIAA Paper 2003-0326; No Copyright; Avail: CASI; A03, Hardcopy

A new parabolized Navier-Stokes (PNS) algorithm has been developed to efficiently compute magnetohydrodynamic (MHD) flows in the low magnetic Reynolds number regime. In this regime, the electrical conductivity is low and the induced magnetic field is negligible compared to the applied magnetic field. The MHD effects are modeled by introducing source terms into the PNS equation which can then be solved in a very efficient manner. To account for upstream (elliptic) effects, the flowfields are computed using multiple streamwise sweeps with an iterated PNS algorithm. Turbulence has been included by modifying the Baldwin-Lomax turbulence model to account for MHD effects. The new algorithm has been used to compute both laminar and turbulent, supersonic, MHD flows over flat plates and supersonic viscous flows in a rectangular MHD accelerator. The present results are in excellent agreement with previous complete Navier-Stokes calculations.
Author
Algorithms; Magnetohydrodynamic Flow; Navier-Stokes Equation; Iteration; Turbulent Flow; Numerical Analysis; Simulation

20040105526 NASA Ames Research Center, Moffett Field, CA, USA

Numerical Simulation of 3-D Supersonic Viscous Flow in an Experimental MHD Channel

Kato, Hiromasa; Tannehill, John C.; Gupta, Sumeet; Mehta, Unmeel B.; [2004]; 13 pp.; In English; 42nd AIAA Aerospace Sciences Meeting and Exhibit, 5-8 Jan. 2004, Reno, NV, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NCC2-5517

Report No.(s): AIAA Paper 2004-0317; No Copyright; Avail: CASI; A03, Hardcopy

The 3-D supersonic viscous flow in an experimental MHD channel has been numerically simulated. The experimental MHD channel is currently in operation at NASA Ames Research Center. The channel contains a nozzle section, a center section, and an accelerator section where magnetic and electric fields can be imposed on the flow. In recent tests, velocity increases of up to 40% have been achieved in the accelerator section. The flow in the channel is numerically computed using a new 3-D parabolized Navier-Stokes (PNS) algorithm that has been developed to efficiently compute MHD flows in the low magnetic Reynolds number regime. The MHD effects are modeled by introducing source terms into the PNS equations which can then be solved in a very e5uent manner. To account for upstream (elliptic) effects, the flowfield can be computed using multiple streamwise sweeps with an iterated PNS algorithm. The new algorithm has been used to compute two test cases that match the experimental conditions. In both cases, magnetic and electric fields are applied to the flow. The computed results are in good agreement with the available experimental data.

Author

Three Dimensional Flow; Supersonic Flow; Magnetohydrodynamic Flow; Simulation; Numerical Analysis; Channel Flow; Viscous Flow

20040105528 NASA Ames Research Center, Moffett Field, CA, USA

Simulation of 3-D Nonequilibrium Seeded Air Flow in the NASA-Ames MHD Channel

Gupta, Sumeet; Tannehill, John C.; Mehta, Unmeel B.; [2004]; 16 pp.; In English; 43rd AIAA Aerospace Sciences Meeting and Exhibit, 10-13 Jan. 2005, Reno, NV, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NCC2-5517

Report No.(s): AIAA Paper 2005-0000; No Copyright; Avail: CASI; A03, Hardcopy

The 3-D nonequilibrium seeded air flow in the NASA-Ames experimental MHD channel has been numerically simulated. The channel contains a nozzle section, a center section, and an accelerator section where magnetic and electric fields can be imposed on the flow. In recent tests, velocity increases of up to 40% have been achieved in the accelerator section. The flow in the channel is numerically computed us ing a 3-D parabolized Navier-Stokes (PNS) algorithm that has been developed to efficiently compute MHD flows in the low magnetic Reynolds number regime: The MHD effects are modeled by introducing source terms into the PNS equations which can then be solved in a very efficient manner. The algorithm has been extended in the present study to account for nonequilibrium seeded air flows. The electrical conductivity of the flow is determined using the program of Park. The new algorithm has been used to compute two test cases that match the experimental conditions. In both cases, magnetic and electric fields are applied to the seeded flow. The computed results are in good agreement with the experimental data.

Author

Air Flow; Magnetohydrodynamic Flow; NASA Programs; Nonequilibrium Flow; Simulation; Numerical Analysis; Three Dimensional Flow; Channel Flow

20040105530 Lockheed Martin Engineering and Sciences Co., Hampton, VA, USA

Computation of Thermally Perfect Oblique Shock Wave Properties

Tatum, Kenneth E.; [1997]; 14 pp.; In English; 35th Aerospace Sciences Meeting and Exhibit, 6-10 Jan. 1997, Reno, NV, USA

Contract(s)/Grant(s): NAS1-96014

Report No.(s): AIAA Paper 97-0868; Copyright; Avail: CASI; A03, Hardcopy

A set of compressible flow relations describing flow properties across oblique shock waves, derived for a thermally perfect, calorically imperfect gas, is applied within the existing thermally perfect gas (TPG) computer code. The relations are based upon the specific heat expressed as a polynomial function of temperature. The updated code produces tables of compressible flow properties of oblique shock waves, as well as the original properties of normal shock waves and basic isentropic flow, in a format similar to the tables for normal shock waves found in NACA Rep. 1135. The code results are validated in both the calorically perfect and the calorically imperfect, thermally perfect temperature regimes through comparisons with the theoretical methods of NACA Rep. 1135. The advantages of the TPG code for oblique shock wave calculations, as well as for the properties of isentropic flow and normal shock waves, are its ease of use and its applicability

to any type of gas (monatomic, diatomic, triatomic, polyatomic, or any specified mixture thereof).
Author
Compressible Flow; Computer Programs; Oblique Shock Waves

20040105533 NASA Langley Research Center, Hampton, VA, USA
Experimental and Computational Studies of the Flow Over a Sting Mounted Planetary Probe Configuration
Holden, Michael S.; Harvey, John K.; Boyd, Iain D.; George, Jyothish; Horvath, Thomas J.; [1997]; 22 pp.; In English; 35th Aerospace Sciences Meeting and Exhibit, 6-10 Jan. 1997, Reno, NV, USA
Contract(s)/Grant(s): F49620-93-1-0373; SDIO-93-C-0001
Report No.(s): AIAA Paper 97-0768; Copyright; Avail: CASI; A03, Hardcopy

This paper summarizes the results of a series of experimental studies in the LENS shock tunnel and computations with DSMC and Navier Stokes codes which have been made to examine the aerothermal and flowfield characteristics of the flow over a sting-supported planetary probe configuration in hypervelocity air and nitrogen flows. The experimental program was conducted in the LENS hypervelocity shock tunnel at total enthalpies of 5and 10 MJkg for a range of reservoir pressure conditions from 70 to 500 bars. Heat transfer and pressure measurements were made on the front and rear face of the probe and along the supporting sting. High-speed and single shot schlieren photography were also employed to examine the flow over the model and the time to establish the flow in the base recirculation region. Predictions of the flowfield characteristics and the distributions of heat transfer and pressure were made with DSMC codes for rarefied flow conditions and with the Navier-Stokes solvers for the higher pressure conditions where the flows were assumed to be laminar. Analysis of the time history records from the heat transfer and pressure instrumentation on the face of the probe and in the base region indicated that the base flow was fully established in under 4 milliseconds from flow initiation or between 35 and 50 flow lengths based on base height. The measurements made in three different tunnel entries with two models of identical geometries but with different instrumentation packages, one prepared by NASA Langley and the second prepared by CUBRC, demonstrated good agreement between heat transfer measurements made with two different types of thin film and coaxial gage instrumentation. The measurements of heat transfer and pressure to the front face of the probe were in good agreement with theoretical predictions from both the DSMC and Navier Stokes codes. For the measurements made in low density flows, computations with the DSMC code were found to compare well with the pressure and heat transfer measurements on the sting, although the computed heat transfer rates in the recirculation region did not exhibit the same characteristics as the measurements. For the 10MJkg and 500 bar reservoir match point condition, the measurements and heat transfer along the sting from the first group of studies were in agreement with the Navier Stokes solutions for laminar conditions. A similar set of measurements made in later tests where the model was moved to a slightly different position in the test section indicated that the boundary layer in the reattachment compression region was close to transition or transitional where small changes in the test environment can result in larger than laminar heating rates. The maximum heating coefficients on the sting observed in the present studies was a small fraction of similar measurements obtained at nominally the same conditions in the HEG shock tunnel, where it is possible for transition to occur in the base flow, and in the low enthalpy studies conducted in the NASA Langley high Reynolds number Mach 10 tunnel where the base flow was shown to be turbulent. While the hybrid Navier- StokedDMSC calculations by Gochberg et al. (Reference 1) suggested that employing the Navier- Stokes calculations for the entire flowfield could be seriously in error in the base region for the 10 MJkg, 500 bar test case, similar calculations performed by Cornell, presented here, do not.
Author
Base Flow; Computerized Simulation; Pressure Measurement; Shock Tunnels

20040105537 NASA, Washington, DC, USA
Transition Effects on Heating in the Wake of a Blunt Body
Hollis, Brian R.; Perkins, John N.; [1997]; 16 pp.; In English; 32nd AIAA Thermophysics Conference, 23-25 Jun. 1997, Atlanta, GA, USA
Contract(s)/Grant(s): NAGW-1331; NAG1-1663
Report No.(s): AIAA Paper 97-2569; Copyright; Avail: CASI; A03, Hardcopy

A series of aerodynamic heating tests was conducted on a 70-deg sphere-cone planetary entry vehicle model in a Mach 10 perfect-gas wind tunnel at freestream Reynolds numbers based on diameter of 8.23x104 to 3.15x105. Surface heating distributions were determined from temperature time-histories measured on the model and on its support sting using thin-film resistance gages. The experimental heating data were compared to computations made using an axisymmetric/2D, laminar, perfect-gas Navier-Stokes solver. Agreement between computational and experimental heating distributions to within, or slightly greater than, the experimental uncertainty was obtained on the forebody and afterbody of the entry vehicle as well as

on the sting upstream of the free-shear-layer reattachment point. However, the distributions began to diverge near the reattachment point, with the experimental heating becoming increasingly greater than the computed heating with distance downstream from the reattachment point. It was concluded that this divergence was due to transition of the wake free shear layer just upstream of the reattachment point on the sting.
Author
Transition Temperature; Wakes; Blunt Bodies; Aerodynamic Heating; Measuring Instruments

20040105591 NASA Langley Research Center, Hampton, VA, USA
DSMC Simulations of Blunt Body Flows for Mars Entries: Mars Pathfinder and Mars Microprobe Capsules
Moss, James N.; Wilmoth, Richard G.; Price, Joseph M.;]1997]; 22 pp.; In English
Report No.(s): AIAA Paper 97-2508; Copyright; Avail: CASI; A03, Hardcopy
The hypersonic transitional flow aerodynamics of the Mars Pathfinder and Mars Microprobe capsules are simulated with the direct simulation Monte Carlo method. Calculations of axial, normal, and static pitching coefficients were obtained over an angle of attack range comparable to actual flight requirements. Comparisons are made with modified Newtonian and free-molecular-flow calculations. Aerothermal results were also obtained for zero incidence entry conditions.
Author
Aerodynamics; Blunt Bodies; Hypersonic Flow; Transition Flow

20040105593 NASA Langley Research Center, Hampton, VA, USA
Transition and Turbulence Modeling for Blunt-Body Wake Flows
Nance, Robert P.; Horvath, Thomas J.; Hassan, H. A.; [1997]; 11 pp.; In English; 32nd AIAA Thermophysics Conference, 23-25 Jun. 1997, Atlanta, GA, USA
Contract(s)/Grant(s): NCC1-112
Report No.(s): AIAA Paper 97-2570; Copyright; Avail: CASI; A03, Hardcopy
This study attempts t o improve the modeling and computational prediction of high- speed transitional wake flows. The recently developed kappa - zeta (Enstrophy) turbulence model is coupled with a newly developed transition prediction method and implemented in an implicit flow solver well-suited to hypersonic flows. In this model, transition onset is determined as part of the solution. Results obtained using the new model for a 70- deg blunted cone/sting geometry demonstrate better agreement with experimental heat- transfer measurements when compared to laminar calculations as well as solutions using the kappa - omega model. Results are also presented for the situation where transition onset is preselected. It is shown that, in this case, results are quite sensitive to location of the transition point.
Author
Wakes; Turbulence Models; High Speed; Hypersonic Flow; Computational Fluid Dynamics

20040105603 NASA Langley Research Center, Hampton, VA, USA
Recent Enhancements to USM3D Unstructured Flow Solver for Unsteady Flows
Pandya, Mohagna J.; Frink, Neal T.; Abdol-Hamid, Khaled S.; Chung, James J.; [2004]; 14 pp.; In English; 22nd AIAA Applied Aerodynamics Conference and Exhibit, 16-19 Aug. 2004, Providence, RI, USA
Report No.(s): AIAA Paper 2004-5201; No Copyright; Avail: CASI; A03, Hardcopy
The NASA USM3D unstructured flow solver is undergoing extensions to address dynamic flow problems in support of NASA and NAVAIR efforts to study the applicability of Computational Fluid Dynamics tools for the prediction of aircraft stability and control characteristics. The initial extensions reported herein include two second-order time stepping schemes, Detached-Eddy Simulation, and grid motion. This paper reports the initial code verification and validation assessment of the dynamic flow capabilities of USM3D. The cases considered are the classic inviscid shock-tube problem, low Reynolds number wake shedding from a NACA 0012 airfoil, high Reynolds number DES-based wake shedding from a 4-to-1 length-to-diameter cylinder, and forced pitch oscillation of a NACA 0012 airfoil with inviscid and turbulent flow.
Author
Computer Programs; Computational Fluid Dynamics; Unsteady Flow; Three Dimensional Flow

20040105629 NASA Langley Research Center, Hampton, VA, USA
Textbook Multigrid Efficiency for the Steady Euler Equations
Roberts, Thomas W.; Sidilkover, David; Swanson, R. C.; [2004]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy
A fast multigrid solver for the steady incompressible Euler equations is presented. Unlike time-marching schemes, this

approach uses relaxation of the steady equations. Application of this method results in a discretization that correctly distinguishes between the advection and elliptic parts of the operator, allowing efficient smoothers to be constructed. Solvers for both unstructured triangular grids and structured quadrilateral grids have been written. Computations for channel flow and flow over a nonlifting airfoil have computed. Using Gauss-Seidel relaxation ordered in the flow direction, textbook multigrid convergence rates of nearly one order-of-magnitude residual reduction per multigrid cycle are achieved, independent of the grid spacing. This approach also may be applied to the compressible Euler equations and the incompressible Navier-Stokes equations.
Author
Multigrid Methods; Euler Equations of Motion; Incompressible Flow; Computational Fluid Dynamics; Steady Flow; Algorithms

20040105653 Lockheed Martin Engineering and Sciences Co., Hampton, VA, USA
Complex Volume Grid Generation Through the Use of Grid Reusability
Alter, Stephen J.; [1997]; 10 pp.; In English; 13th AIAA Computational Fluid Dynamics Conference, 29 Jun. - 2 Jul. 1997, Snowmass, CO, USA
Contract(s)/Grant(s): NAS1-96014; NAS1-20255
Report No.(s): AIAA Paper 97-1987; Copyright; Avail: CASI; A02, Hardcopy

This paper presents a set of surface and volume grid generation techniques which reuse existing surface and volume grids. These methods use combinations of data manipulations to reduce grid generation time, improve grid characteristics, and increase the capabilities of existing domain discretization software. The manipulation techniques utilize physical and computational domains to produce basis function on which to operate and modify grid character and smooth grids using Trans-Finite Interpolation, a vector interpolation method and parametric re-mapping technique. With these new techniques, inviscid grids can be converted to viscous grids, multiple zone grid adaption can be performed to improve CFD solver efficiency, and topological changes to improve modeling of flow fields can be done simply and quickly. Examples of these capabilities are illustrated as applied to various configurations.
Derived from text
Computational Fluid Dynamics; Flow Distribution; Grid Generation (Mathematics); Flow Deflection

20040105662 Kentucky Univ., Lexington, KY, USA
Large Eddy Simulation of Flow in Turbine Cascades Using LESTool and UNCLE Codes
Huang, P. G.; January 2004; 49 pp.; In English
Contract(s)/Grant(s): WKI-516140-02-06; NAG2-099; No Copyright; Avail: CASI; A03, Hardcopy

During the period December 23,1997 and December August 31,2004, we accomplished the development of 2 CFD codes for DNS/LES/RANS simulation of turbine cascade flows, namely LESTool and UNCLE. LESTool is a structured code making use of 5th order upwind differencing scheme and UNCLE is a second-order-accuracy unstructured code. LESTool has both Dynamic SGS and Spalart's DES models and UNCLE makes use of URANS and DES models. The current report provides a description of methodologies used in the codes.
Author
Cascade Flow; Computational Fluid Dynamics; Large Eddy Simulation; Turbines; Computer Programs

20040110238 NASA Langley Research Center, Hampton, VA, USA
Self-Contained Automated Methodology for Optimal Flow Control
Joslin, Ronald D.; Gunzburger, Max D.; Nicolaides, Roy A.; Erlebacherl, Gordon; Hussaini, M. Yousuff; [1997]; 31 pp.; In English
Contract(s)/Grant(s): NAS1-19480; AFOSR-93-1-0280; No Copyright; Avail: CASI; A03, Hardcopy

This paper describes a self-contained, automated methodology for active flow control which couples the time-dependent Navier-Stokes system with an adjoint Navier-Stokes system and optimality conditions from which optimal states, i.e., unsteady flow fields and controls (e.g., actuators), may be determined. The problem of boundary layer instability suppression through wave cancellation is used as the initial validation case to test the methodology. Here, the objective of control is to match the stress vector along a portion of the boundary to a given vector; instability suppression is achieved by choosing the given vector to be that of a steady base flow. Control is effected through the injection or suction of fluid through a single orifice on the boundary. The results demonstrate that instability suppression can be achieved without any a priori knowledge of the disturbance, which is significant because other control techniques have required some knowledge of the flow unsteadiness

such as frequencies, instability type, etc. The present methodology has been extended to three dimensions and may potentially be applied to separation control, re-laminarization, and turbulence control applications using one to many sensors and actuators.
Author
Active Control; Boundary Layers; Control Systems Design; Navier-Stokes Equation; Optimal Control

20040110258 NASA Langley Research Center, Hampton, VA, USA
Large-Eddy Simulation of Transition to Turbulence in Boundary Layers
Huai, Xiao-Li; Joslin, Ronald D.; Piomelli, Ugo; [1997]; 21 pp.; In English
Contract(s)/Grant(s): NAG1-1089; No Copyright; Avail: CASI; A03, Hardcopy

Large-eddy simulation results for laminar-to-turbulent transition in a spatially developing boundary layer are presented. The disturbances are ingested into a laminar flow through an unsteady suction-and-blowing strip. The filtered, three-dimensional time- dependent Navier-Stokes equations are integrated numerically using spectral, high-order finite-difference, and three-stage low-storage Runge-Kutta methods. The buffer-domain technique is used for the outflow boundary condition. The localized dynamic model used to parameterize the subgrid-scale stresses begins to have a significant impact at the beginning of the nonlinear transition (or intermittency) region. The flow structures commonly found in experiments are also observed in the present simulation; the computed linear instability modes and secondary instability lambda-vortex structures are in agreement with the experiments, and the streak-like-structures and turbulent statistics compare with both the experiments and the theory. The physics captured in the present LES are consistent with the experiments and the full Navier-Stokes simulation (DNS), at a significant fraction of the DNS cost. A comparison of the results obtained with several SGS models shows that the localized model gives accurate results both in a statistical sense and in terms of predicting the dynamics of the energy-carrying eddies, without ad hoc adjustments.
Author
Large Eddy Simulation; Boundary Layer Flow; Turbulence Models; Laminar Flow; Eddy Viscosity

20040110264 NASA Langley Research Center, Hampton, VA, USA
An Analytical Comparison of the Acoustic Analogy and Kirchhoff Formulation for Moving Surfaces
Brentner, Kenneth S.; Farassat, F.; [1997]; 10 pp.; In English; American Helicopter Society 53rd Annual Forum, 29 Apr. - 1 May 1997, Virginia Beach, VA, USA; No Copyright; Avail: CASI; A02, Hardcopy

The Lighthill acoustic analogy, as embodied in the Ffowcs Williams-Hawkings (FW-H) equation, is compared with the Kirchhoff formulation for moving surfaces. A comparison of the two governing equations reveals that the main Kirchhoff advantage (namely nonlinear flow effects are included in the surface integration) is also available to the FW-H method if the integration surface used in the FW-H equation is not assumed impenetrable. The FW-H equation is analytically superior for aeroacoustics because it is based upon the conservation laws of fluid mechanics rather than the wave equation. This means that the FW-H equation is valid even if the integration surface is in the nonlinear region. This is demonstrated numerically in the paper. The Kirchhoff approach can lead to substantial errors if the integration surface is not positioned in the linear region. These errors may be hard to identify. Finally, new metrics based on the Sobolev norm are introduced which may be used to compare input data for both quadrupole noise calculations and Kirchhoff noise predictions.
Author
Aeroacoustics; Analogies; Kirchhoff Law; Computational Fluid Dynamics; Noise Prediction (Aircraft)

20040110265 NASA Langley Research Center, Hampton, VA, USA
Tetrahedral Finite-Volume Solutions to the Navier-Stokes Equations on Complex Configurations
Frink, N. T.; Pirzadeh, S. Z.; [1998]; 12 pp.; In English; Tenth International Conference on Finite Elements in Fluids, 5-8 Jan. 1998, Tucson, AZ, USA; Copyright; Avail: CASI; A03, Hardcopy

A review of the algorithmic features and capabilities of the unstructured-grid flow solver USM3Dns is presented. This code, along with the tetrahedral grid generator, VGRIDns, is being extensively used throughout the U.S. for solving the Euler and Navier-Stokes equations on complex aerodynamic problems. Spatial discretization is accomplished by a tetrahedral cell-centered finite-volume formulation using Roe's upwind flux difference splitting. The fluxes are limited by either a Superbee or MinMod limiter. Solution reconstruction within the tetrahedral cells is accomplished with a simple, but novel, multidimensional analytical formula. Time is advanced by an implicit backward-Euler time-stepping scheme. Flow turbulence effects are modeled by the Spalart-Allmaras one-equation model, which is coupled with a wall function to reduce the number of cells in the near-wall region of the boundary layer. The issues of accuracy and robustness of USM3Dns Navier-Stokes

capabilities are addressed for a flat-plate boundary layer, and a full F-16 aircraft with external stores at transonic speed.
Author
Algorithms; Finite Volume Method; Mathematical Models; Navier-Stokes Equation; Tetrahedrons; Unstructured Grids (Mathematics); F-16 Aircraft; Aircraft Configurations

20040110280 Georgia Inst. of Tech., Atlanta, GA, USA
Non-Coalescence in Microgravity: Science and Technology
Neitzel, G. Paul; August 2004; 4 pp.; In English
Contract(s)/Grant(s): NAG3-2431; No Copyright; Avail: CASI; A01, Hardcopy

Non-coalescence of two bodies of the same liquid and the suppression of contact between liquid drops and solid surfaces (nonwetting) has been studied through a pair of parallel investigations being conducted at the Georgia Institute of Technology and the Microgravity Research and Support (MARS) Center in Naples, Italy. Both non- coalescence and nonwetting may achieved by either: i) exploiting the mechanism of thermocapillary convection to drive a lubricating film of surrounding gas (air) into the space between the two liquid free surfaces (non-coalescence) or between the drop free surface and the solid (nonwetting); or ii) using the otherwise forced motion of the solid (or one liquid) surface to generate the lubricating film. These, and other types of related phenomena are discussed in our recent review article (Neitzel GP, Dell'Aversana P. 2002. Noncoalescence and nonwetting behavior of liquids. Annual Review of Fluid Mechanics 34: 267-89). This project was a continuation of earlier research on this subject and includes the possible uses of non-coalescing/wetting systems in technological applications.
Author
Microgravity; Research and Development; Drops (Liquids); Fluid Mechanics; Solid Surfaces

20040110283 NASA Langley Research Center, Hampton, VA, USA
Overview of Active Flow Control at NASA Langley Research Center
Pack, L. G.; Joslin, R. D.; [1998]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The paper summarizes Active Flow Control projects currently underway at the NASA Langley Research Center. Technology development is being pursued within a multidisciplinary, cooperative approach, involving the classical disciplines of fluid mechanics, structural mechanics, material science, acoustics, and stability and control theory. Complementing the companion papers in this session, the present paper will focus on projects that have the goal of extending the state-of-the-art in the measurement, prediction, and control of unsteady, nonlinear aerodynamics. Toward this goal, innovative actuators, micro and macro sensors, and control strategies are considered for high payoff flow control applications. The target payoffs are outlined within each section below. Validation of the approaches range from bench-top experiments to wind-tunnel experiments to flight tests. Obtaining correlations for future actuator and sensor designs are implicit in the discussion. The products of the demonstration projects and design tool development from the fundamental NASA R&D level technology will then be transferred to the Applied Research components within NASA, DOD, and US Industry. Keywords: active flow control, separation control, MEMS, review
Author
Flow Distribution; Active Control; Boundary Layer Separation; Stability; Unsteady Aerodynamics

20040110294 NASA Langley Research Center, Hampton, VA, USA
Aircraft Laminar Flow Control
Joslin, Ronald D.; Annual Review of Fluid Mechanics 1998; 1998; Volume 30, pp. 1-29; In English; Copyright; Avail: CASI; A03, Hardcopy

Aircraft laminar flow control (LFC) from the 1930's through the 1990's is reviewed and the current status of the technology is assessed. Examples are provided to demonstrate the benefits of LFC for subsonic and supersonic aircraft. Early studies related to the laminar boundary-layer flow physics, manufacturing tolerances for laminar flow, and insect-contamination avoidance are discussed. LFC concept studies in wind-tunnel and flight experiments are the major focus of the paper. LFC design tools are briefly outlined for completeness.
Author
Boundary Layer Control; Contamination; Fluid Dynamics; Laminar Boundary Layer; Laminar Flow

20040110303 NASA Langley Research Center, Hampton, VA, USA
Impact of Thermal Gradients on Wind Tunnel Force Measurements
Hereford, James; Parker, Peter A.; Rhew, Ray D.; [1999]; 13 pp.; In English; 37th AIAA Aerospace Sciences Meeting and Exhibit, 11-14 Jan. 1999, Reno, NV, USA
Report No.(s): AIAA Paper 99-0309; Copyright; Avail: CASI; A03, Hardcopy

In a wind tunnel facility, the direct measurement of forces and moments induced on the model are performed by a force measurement balance. The measurement balance is a precision-machined device that has strain gages at strategic locations to measure the strain (i.e., deformations) due to applied forces and moments. The strain gages convert the strain (and hence the applied force) to an electrical voltage that is measured by external meters. Thermal gradients can complicate the process, however. Thermal gradients on the balance cause differential expansion (or contraction) of various parts of the balance that induce a strain that is detected by the strain gages and is indistinguishable from an external applied force. The thermal gradients can result when testing is done at elevated temperatures or at cryogenic temperatures such as at the National Transonic Facility (NTF) at NASA Langley Research Center (LaRC).
Author
Force Distribution; Wind Tunnel Tests; Balance; Strain Gages; Electric Potential; Temperature Gradients

20040110317 NASA Langley Research Center, Hampton, VA, USA
Recent NASA Wake-Vortex Flight Tests, Flow-Physics Database and Wake-Development Analysis
Vicroy, Dan D.; Vijgen, Paul M.; Reimer, Heidi M.; Gallegos, Joey L.; Spalart, Philippe R.; [1998]; 14 pp.; In English
Contract(s)/Grant(s): NAS1-20267
Report No.(s): Rept-985592; No Copyright; Avail: CASI; A03, Hardcopy

A series of flight tests over the ocean of a four engine turboprop airplane in the cruise configuration have provided a data set for improved understanding of wake vortex physics and atmospheric interaction. An integrated database has been compiled for wake characterization and validation of wake-vortex computational models. This paper describes the wake-vortex flight tests, the data processing, the database development and access, and results obtained from preliminary wake-characterization analysis using the data sets.
Author
Data Bases; Flight Tests; Vortices; Aircraft Wakes; Mathematical Models; NASA Programs; Flow Distribution; Turboprop Aircraft

20040110322 NASA Langley Research Center, Hampton, VA, USA
On Some Numerical Dissipation Schemes
Swanson, R. C.; Radespiel, R.; Turkel, E.; [1998]; 41 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Several schemes for introducing an artificial dissipation into a central difference approximation to the Euler and Navier Stokes equations are considered. The focus of the paper is on the convective upwind and split pressure (CUSP) scheme, which is designed to support single interior point discrete shock waves. This scheme is analyzed and compared in detail with scalar dissipation and matrix dissipation (MATD) schemes. Resolution capability is determined by solving subsonic, transonic, and hypersonic flow problems. A finite-volume discretization and a multistage time-stepping scheme with multigrid are used to compute solutions to the flow equations. Numerical solutions are also compared with either theoretical solutions or experimental data. For transonic airfoil flows the best accuracy on coarse meshes for aerodynamic coefficients is obtained with a simple MATD scheme. The coarse-grid accuracy for the original CUSP scheme is improved by modifying the limiter function used with the scheme, giving comparable accuracy to that obtained with the MATD scheme. The modifications reduce the background dissipation and provide control over the regions where the scheme can become first order.
Author
Finite Volume Method; Flow Equations; Discretization (Mathematics); Scalars

20040110331 NASA Langley Research Center, Hampton, VA, USA
Relaxation Revisited: A Fresh Look at Multigrid for Steady Flows
Roberts, Thomas W.; Swanson, R. C.; Sidilkover, David; [1997]; 19 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The year 1971 saw the publication of one of the landmark papers in computational aerodynamics, that of Murman and Cole. As with many seminal works, its significance lies not so much in the specific problem that it addressed| small disturbance, plane transonic flow - but in the identification of a general approach to the solution of a technically important and

theoretically difficult problem. The key features of Murman and Cole's work were the use of type- dependent differencing to correctly account for the proper domain of dependence of a mixed elliptic/hyperbolic equation, and the introduction of line relaxation to solve the steady flow equation. All subsequent work in transonic potential flows was based on these concepts. Jameson extended Murman and Cole's ideas to the full potential equation with two important contributions. First, he introduced the rotated difference stencil, which generalized the Murman and Cole type-dependent difference operator to general coordinates. Second, he used the interpretation, introduced by Garabedian, of relaxation as an iteration in artificial time to construct stable relaxation schemes, generalizing the original line relaxation method of Reference. The decade of the 1970s saw an explosion of activity in the solution of transonic potential flows, which has been summarized in the review article of Caughey.
Derived from text
Computational Fluid Dynamics; Flow Equations; Aerodynamics; Steady Flow

20040110336 NASA Langley Research Center, Hampton, VA, USA
Reynolds Number, Compressibility, and Leading-Edge Bluntness Effects on Delta-Wing Aerodynamics
Luckring, James M.; [2004]; 14 pp.; In English; 24th International Congress of the Aeronautical Sciences, 2004; No Copyright; Avail: CASI; A03, Hardcopy

An overview of Reynolds number, compressibility, and leading edge bluntness effects is presented for a 65 degree delta wing. The results of this study address both attached and vortex-flow aerodynamics and are based upon a unique data set obtained in the NASA-Langley National Transonic Facility (NTF) for i) Reynolds numbers ranging from conventional wind-tunnel to flight values, ii) Mach numbers ranging from subsonic to transonic speeds, and iii) leading-edge bluntness values that span practical slender wing applications. The data were obtained so as to isolate the subject effects and they present many challenges for Computational Fluid Dynamics (CFD) studies.
Author
Compressibility; Computational Fluid Dynamics; Delta Wings; Reynolds Number; Wind Tunnel Models; Blunt Leading Edges

20040110351 NASA Langley Research Center, Hampton, VA, USA
Evaluation of a CFD Method for Aerodynamic Database Development using the Hyper-X Stack Configuration
Parikh, Paresh; Engelund, Walter; Armand, Sasan; Bittner, Robert; August 10, 2004; 11 pp.; In English; 22nd AIAA Applied Aerodynamics Conference and Exhibit, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 754-30-20
Report No.(s): AIAA Paper 2004-5385; Copyright; Avail: CASI; A03, Hardcopy

A computational fluid dynamic (CFD) study is performed on the Hyper-X (X-43A) Launch Vehicle stack configuration in support of the aerodynamic database generation in the transonic to hypersonic flow regime. The main aim of the study is the evaluation of a CFD method that can be used to support aerodynamic database development for similar future configurations. The CFD method uses the NASA Langley Research Center developed TetrUSS software, which is based on tetrahedral, unstructured grids. The Navier-Stokes computational method is first evaluated against a set of wind tunnel test data to gain confidence in the code s application to hypersonic Mach number flows. The evaluation includes comparison of the longitudinal stability derivatives on the complete stack configuration (which includes the X-43A/Hyper-X Research Vehicle, the launch vehicle and an adapter connecting the two), detailed surface pressure distributions at selected locations on the stack body and component (rudder, elevons) forces and moments. The CFD method is further used to predict the stack aerodynamic performance at flow conditions where no experimental data is available as well as for component loads for mechanical design and aero-elastic analyses. An excellent match between the computed and the test data over a range of flow conditions provides a computational tool that may be used for future similar hypersonic configurations with confidence.
Author
Computational Fluid Dynamics; Data Bases; Wind Tunnel Tests; X-43 Vehicle; Aerodynamic Configurations

20040110423 NASA Langley Research Center, Hampton, VA, USA
Simulation of Nonlinear Instabilities in an Attachment-Line Boundary Layer
Joslin, Ronald D.; [1996]; 37 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The linear and the nonlinear stability of disturbances that propagate along the attachment line of a three-dimensional boundary layer is considered. The spatially evolving disturbances in the boundary layer are computed by direct numerical simulation (DNS) of the unsteady, incompressible Navier-Stokes equations. Disturbances are introduced either by forcing at the in ow or by applying suction and blowing at the wall. Quasi-parallel linear stability theory and a nonparallel theory yield

notably different stability characteristics for disturbances near the critical Reynolds number; the DNS results con rm the latter theory. Previously, a weakly nonlinear theory and computations revealed a high wave-number region of subcritical disturbance growth. More recent computations have failed to achieve this subcritical growth. The present computational results indicate the presence of subcritically growing disturbances; the results support the weakly nonlinear theory. Furthermore, an explanation is provided for the previous theoretical and computational discrepancy. In addition, the present results demonstrate that steady suction can be used to stabilize disturbances that otherwise grow subcritically along the attachment line.
Author
Nonlinearity; Stability; Three Dimensional Boundary Layer; Direct Numerical Simulation

20040110438 NASA Langley Research Center, Hampton, VA, USA
Implicit/Multigrid Algorithms for Incompressible Turbulent Flows on Unstructured Grids
Anderson, W. Kyle; Rausch, Russ D.; Bonhaus, Daryl L.; [1997]; 15 pp.; In English
Report No.(s): AIAA Paper 95-1740; Copyright; Avail: CASI; A03, Hardcopy

An implicit code for computing inviscid and viscous incompressible flows on unstructured grids is described. The foundation of the code is a backward Euler time discretization for which the linear system is approximately solved at each time step with either a point implicit method or a preconditioned Generalized Minimal Residual (GMRES) technique. For the GMRES calculations, several techniques are investigated for forming the matrix-vector product. Convergence acceleration is achieved through a multigrid scheme that uses non-nested coarse grids that are generated using a technique described in the present paper. Convergence characteristics are investigated and results are compared with an exact solution for the inviscid flow over a four-element airfoil. Viscous results, which are compared with experimental data, include the turbulent flow over a NACA 4412 airfoil, a three-element airfoil for which Mach number effects are investigated, and three-dimensional flow over a wing with a partial-span flap.
Author
Algorithms; Turbulent Flow; Unstructured Grids (Mathematics); Multigrid Methods; Incompressible Flow; Computational Fluid Dynamics

20040110439 NASA Langley Research Center, Hampton, VA, USA
Active Control of Instabilities in Laminar Boundary Layers-Overview and Concept Validation
Joslin, Ronald D.; Erlebacher, Gordon; Hussaini, M. Yoursuff; [1997]; 14 pp.; In English
Contract(s)/Grant(s): NAS1-19480; No Copyright; Avail: CASI; A03, Hardcopy

This paper (the first in a series) focuses on using active-control methods to maintain laminar flow in a region of the flow in which the natural instabilities, if left unattended, lead to turbulent flow. The authors review previous studies that examine wave cancellation (currently the most prominent method) and solve the unsteady, nonlinear Navier-Stokes equations to evaluate this method of controlling instabilities. It is definitively shown that instabilities are controlled by the linear summation of waves (i.e., wave cancellation). Although a mathematically complete method for controlling arbitrary instabilities has been developed, the review, duplication, and physical explanation of previous studies are important steps for providing an independent verification of those studies, for establishing a framework for the work which will involve automated transition control, and for detailing the phenomena by-which the automated studies can be used to expand knowledge of flow control.
Author
Active Control; Laminar Boundary Layer; Nonlinear Equations

20040110516 Texas A&M Univ., College Station, TX
Large Eddy Simulation of the Lattice Boltzmann Equation for Turbulent Combustion
Girimaji, Sharath S.; Yu, Huidan; Yu, Dazhi; Luo, Li-Shi; Mar. 31, 2004; 192 pp.; In English
Contract(s)/Grant(s): F49620-01-1-0142; Proj-2308
Report No.(s): AD-A425416; AFRL-SR-AR-TR-04-0417; No Copyright; Avail: CASI; A09, Hardcopy

The Lattice Boltzmann equation (LBE) was used to perform direct numerical simulations (DNS) and large-eddy simulations (LES) of benchmark problems in turbulence, scalar mixing, and reaction. The most important contribution was the development of LBE theory for binary mixing, which can be extended in a straight-forward manner to multi-scalar mixing. Computational simulations were performed to verify that the desired diffusive effects could be achieved in classical mixing problems. It was demonstrated that the shape of the probability density functions during binary mixing from non- premixed initial conditions was captured precisely. The technique for handling reactions in the LBE context also was demonstrated. In the standard one-dimensional flame propagation problem, the burning rate was captured accurately. The third significant

contribution was the adaptation of the multi-time-scale relaxation technique to LES. Several DNS and LES calculations of benchmark turbulent flows (decaying isotropic and homogeneous shear, square jet) were performed to establish the effectiveness and efficiency of LBE. The decay exponent in decaying turbulence, the equilibrium anisotropies in homogeneous turbulence, and the spread rates in square jets were calculated accurately.
DTIC
Boltzmann Transport Equation; Combustion; Large Eddy Simulation; Propulsion System Configurations; Propulsion System Performance; Turbulent Combustion; Turbulent Flow

20040110742 NASA Langley Research Center, Hampton, VA, USA
Absolute Equilibrium Entropy
Shebalin, John V.; [1997]; 11 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The entropy associated with absolute equilibrium ensemble theories of ideal, homogeneous, fluid and magneto-fluid turbulence is discussed and the three-dimensional fluid case is examined in detail. A sigma-function is defined, whose minimum value with respect to global parameters is the entropy. A comparison is made between the use of global functions sigma and phase functions H (associated with the development of various H-theorems of ideal turbulence). It is shown that the two approaches are complimentary though conceptually different: H-theorems show that an isolated system tends to equilibrium while sigma-functions allow the demonstration that entropy never decreases when two previously isolated systems are combined. This provides a more complete picture of entropy in the statistical mechanics of ideal fluids.
Author
Entropy; Equilibrium Methods; Homogeneous Turbulence

20040110801 Alpha Technology, Huntsville, AL, USA
CFM Analysis, Documentation, and Planning Support
Hastings, Leon J.; September 07, 2004; 2 pp.; In English
Contract(s)/Grant(s): NAS8-01183; No Copyright; Avail: CASI; A01, Hardcopy

The Multipurpose Hydrogen Test Bed (MHTB) Test Readiness Review (TRR), in preparation for upcoming thermodynamic vent system testing with LN2 (an LO2 simulant), was conducted on Aug 10 with no significant concerns or open action items. The 21 day test series, designed to evaluate the spray bar mixer/vent system concept suitability for zero-g operation began on August 19. The testing is progressing very well and results indicate that the Moog latching valve is more effective than the Castor solenoid valve in reducing pressure during the vent/mixing cycles. Testing with self-pressurization is expected to be completed on September 3 and testing with helium pressurization will be initiated on September 4 or 5. Additional activities during first half of August included coordination of Notification of Intent (NOI) to propose letters involving CFM in response to the HR&T BAA for Extramural Proposals.
Author
Thermodynamics; Vents; Mixers; Liquid Hydrogen; Computational Fluid Dynamics; Weightlessness; Ground Tests

20040110809 NASA Langley Research Center, Hampton, VA, USA
Simulation of Three-Dimensional Symmetric and Asymmetric Instabilities in Attachment-Line Boundary Layers
Joslin, Ronald D.; AIAA Journal; 1996; Volume 34, No. 11, pp. 2432-2434; In English; Copyright; Avail: CASI; A01, Hardcopy

On a swept wing, contamination along the leading edge, Tollmien-Schlichting waves, stationary or traveling crossflow vortices, and/or Taylor-Gortler vortices can cause the catastrophic breakdown of laminar to turbulent flow, which leads to increased skin-friction drag for the aircraft. The discussion in this Note will be limited to disturbances which evolve along the attachment line (leading edge of swept wing). If the Reynolds number of the attachment-line boundary layer is greater than some critical value, then the complete wing is inevitably engulfed in turbulent flow. Essentially, there are two critical Reynolds number points that must be considered. The first is for small-amplitude disturbances, and the second is for bypass transition. The present study will use direct numerical simulations to validate a linear 2D-eigenvalue prediction method based on parabolized stability equations by Lin and Malik. This method is considered because it suggests that a number of symmetric and asymmetric modes exist and are stable or unstable on the attachment line depending on the Reynolds number. If validated, the approach would predict a number of modes which are linearly damped in the Reynolds number regime 100 to 245; however, these modes may grow nonlinearly and provide an explanation to this region.
Author (revised)
Boundary Layer Flow; Unsteady Flow; Two Dimensional Models; Three Dimensional Models

20040110813 NASA Langley Research Center, Hampton, VA, USA

Effects of H2O Vapor on Vibrational Relaxation in Expanding and Contracting Flows

Meador, Willard E.; Townsend, Lawrence W.; Miner, Gilda A.; [1996]; 7 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

As opposed to previous explanations based on the effects of anharmonicity of simple diatomic molecules, traces of water vapor are suggested to be the most likely cause of the anomalously fast vibrational relaxation of such gases observed in supersonic and hypersonic nozzles. The mechanism is the strong V-VR coupling with H2O molecules that dramatically facilitates the collisional transfer of vibrational energy. Slight moisture content is thus a real world aspect of gas dynamics that must be considered in characterizations of shock tubes, reflected shock tunnels, and expansion tubes.

Author

Molecular Relaxation; Water Vapor; Gas Dynamics; Diatomic Molecules; Shock Tunnels

20040110814 NASA Langley Research Center, Hampton, VA, USA

Aerodynamic Characteristics of an Aerospace Vehicle During a Subsonic Pitch-Over Maneuver

Kleb, William L.; [1996]; 12 pp.; In English

Report No.(s): AIAA Paper 96-0825; Copyright; Avail: CASI; A03, Hardcopy

Time-dependent CFD has been used to predict aerospace vehicle aerodynamics during a subsonic rotation maneuver. The inviscid 3D3U code is employed to solve the 3-D unsteady flow field using an unstructured grid of tetrahedra. As this application represents a challenge to time-dependent CFD, observations concerning spatial and temporal resolution are included. It is shown that even for a benign rotation rate, unsteady aerodynamic effects are significant during the maneuver. Possibly more significant, however, the rotation maneuver creates ow asymmetries leading to yawing moment, rolling moment, and side force which are not present in the quasi-steady case. A series of steady solutions at discrete points in the maneuver are also computed for comparison with wind tunnel measurements and as a means of quantifying unsteady effects.

Author

Aerodynamic Characteristics; Aerospace Vehicles; Subsonic Flow; Computational Fluid Dynamics; Spacecraft Maneuvers

20040110824 NASA Langley Research Center, Hampton, VA, USA

Hypersonic Boundary Layer Stability over a Flared Cone in a Quiet Tunnel

Lachowicz, Jason T.; Chokani, Ndaona; Wilkinson, Stephen P.; [1996]; 11 pp.; In English

Contract(s)/Grant(s): NCC1-20192; Copyright; Avail: CASI; A03, Hardcopy

Hypersonic boundary layer measurements were conducted over a flared cone in a quiet wind tunnel. The flared cone was tested at a freestream unit Reynolds number of 2.82x106/ft in a Mach 6 flow. This Reynolds number provided laminar-to-transitional flow over the model in a low-disturbance environment. Point measurements with a single hot wire using a novel constant voltage anemometry system were used to measure the boundary layer disturbances. Surface temperature and schlieren measurements were also conducted to characterize the laminar-to-transitional state of the boundary layer and to identify instability modes. Results suggest that the second mode disturbances were the most unstable and scaled with the boundary layer thickness. The integrated growth rates of the second mode compared well with linear stability theory in the linear stability regime. The second mode is responsible for transition onset despite the existence of a second mode sub-harmonic. The sub-harmonic wavelength also scales with the boundary layer thickness. Furthermore, the existence of higher harmonics of the fundamental suggests that non-linear disturbances are not associated with high free stream disturbance levels.

Author

Boundary Layer Stability; Hypersonic Boundary Layer; Wind Tunnels; Flared Bodies; Cones

20040110856 NASA Langley Research Center, Hampton, VA, USA

Computation of Thermally Perfect Compressible Flow Properties

Witte, David W.; Tatum, Kenneth E.; Williams, S. Blake; [1996]; 19 pp.; In English; 34th Aerospace Sciences Meeting and Exhibit, 15-18 Jan. 1996, Reno, NV, USA

Report No.(s): AIAA Paper 96-0681; Copyright; Avail: CASI; A03, Hardcopy

A set of compressible flow relations for a thermally perfect, calorically imperfect gas are derived for a value of c(sub p) (specific heat at constant pressure) expressed as a polynomial function of temperature and developed into a computer program, referred to as the Thermally Perfect Gas (TPG) code. The code is available free from the NASA Langley Software Server at URL http://www.larc.nasa.gov/LSS. The code produces tables of compressible flow properties similar to those found in NACA

Report 1135. Unlike the NACA Report 1135 tables which are valid only in the calorically perfect temperature regime the TPG code results are also valid in the thermally perfect, calorically imperfect temperature regime, giving the TPG code a considerably larger range of temperature application. Accuracy of the TPG code in the calorically perfect and in the thermally perfect, calorically imperfect temperature regimes are verified by comparisons with the methods of NACA Report 1135. The advantages of the TPG code compared to the thermally perfect, calorically imperfect method of NACA Report 1135 are its applicability to any type of gas (monatomic, diatomic, triatomic, or polyatomic) or any specified mixture of gases, ease-of-use, and tabulated results.
Author
Compressible Flow; Flow Characteristics; One Dimensional Flow; Computer Programs

20040110857 NASA Langley Research Center, Hampton, VA, USA
Numerical Simulation of Wake Vortices Measured During the Idaho Falls and Memphis Field Programs
Proctor, Fred H.; [1996]; 19 pp.; In English; 14th AIAA Applied Aerodynamic Conference, 17-20 Jun. 1996, New Orleans, LA, USA
Report No.(s): AIAA Paper 96-2496; Copyright; Avail: CASI; A03, Hardcopy

A numerical large-eddy simulation model is under modification and testing for application to aircraft wake vortices. The model, having a meteorological framework, permits the interaction of wake vortices with environments characterized by crosswind shear, stratification, and humidity. As part of the validation process, model results are compared with measured field data from the 1990 Idaho Falls and the 1994-1995 Memphis field experiments. Cases are selected that represent different aircraft and a cross section of meteorological environments. Also included is one case with wake vortex generation in ground effect. The model simulations are initialized with the appropriate meteorological conditions and a post roll-up vortex system. No ambient turbulence is assumed in our initial set of experiments, although turbulence can be self generated by the interaction of the model wakes with the ground and environment.
Author
Large Eddy Simulation; Vortices; Aircraft Wakes; Mathematical Models; Idaho; Systems Simulation; Tennessee

20040110895 North Carolina State Univ., Raleigh, NC, USA
Comparison of Experimental and Computational Aerothermodynamics of a 70-deg Sphere-Cone
Hollis, Brian R.; Perkins, John N.; January 2004; 13 pp.; In English; 31st AIAA Thermophysics Conference, 18-20 Jun. 1996, New Orleans, LA, USA
Contract(s)/Grant(s): NAGW-1331; NAG1-1663
Report No.(s): AIAA Paper 96-1867; Copyright; Avail: CASI; A03, Hardcopy

Numerical solutions for hypersonic flows of carbon-dioxide and air around a 70-deg sphere-cone have been computed using an axisymmetric non-equilibrium Navier-Stokes solver. Freestream flow conditions for these computations were equivalent to those obtained in an experimental blunt-body heat-transfer study conducted in a high-enthalpy, hypervelocity expansion tube. Comparisons have been made between the computed and measured surface heat-transfer rates on the forebody and afterbody of the sphere-cone and on the sting which supported the test model. Computed forebody heating rates were within the estimated experimental uncertainties of 10% on the forebody and 15% in the wake except for within the recirculating flow region of the wake.
Author
Aerothermodynamics; Hypersonic Flow; Numerical Analysis; Cones; Spheres; Navier-Stokes Equation

20040110896 Lockheed Martin Engineering and Sciences Co., Hampton, VA, USA
Elliptic Volume Grid Generation for Viscous CFD Parametric Design Studies
Alter, Stephen J.; Cheatwood, F. McNeil; [1996]; 10 pp.; In English
Report No.(s): AIAA Paper 96-1999; Copyright; Avail: CASI; A02, Hardcopy

This paper presents a robust method for the generation of zonal volume grids of design parametrics for aerodynamic configurations. The process utilizes simple algebraic techniques with parametric splines coupled with elliptic volume grid generation to generate isolated zonal grids for changes in body configuration needed to perform parametric design studies. Speed of the algorithm is maximized through the algebraic methods and reduced number of grid points to be regenerated for each design parametric without sacrificing grid quality and continuity within the volume domain. The method is directly applicable to grid reusability, because it modifies existing ow adapted volume grids and enables the user to restart the CFD solution process with an established flow field. Use of this zonal approach reduces computer usage time to create new volume

grids for design parametric studies by an order of magnitude, as compared to current methods which require the regeneration of an entire volume grid. A sample configuration of a proposed Single Stage-to-Orbit Vehicle is used to illustrate an application of this method.
Author
Aerodynamic Configurations; Computational Fluid Dynamics; Grid Generation (Mathematics); Viscous Flow; Ellipticity; Parameterization

20040110902 NASA Glenn Research Center, Cleveland, OH, USA
Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows
LaGraff, John E., Editor; Ashpis, David E.; August 2004; 640 pp.; In English; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows, 17-20 Aug. 2003, Blue Mountain Lake, NY, USA; See also 20040110903 - 20040110933
Contract(s)/Grant(s): WBS 22-714-30-10
Report No.(s): NASA/TM-2004-212913/SUPPL; E-14349; No Copyright; Avail: CASI; C01, CD-ROM

This Minnowbrook IV 2003 workshop on Transition and Unsteady Aspects of Turbomachinery Flows includes the following topics: 1) Current Issues in Unsteady Turbomachinery Flows; 2) Global Instability and Control of Low-Pressure Turbine Flows; 3) Influence of End Wall Leakage on Secondary Flow Development in Axial Turbines; 4) Active and Passive Flow Control on Low Pressure Turbine Airfoils; 5) Experimental and Numerical Investigation of Transitional Flows as Affected by Passing Wakes; 6) Effects of Freestream Turbulence on Turbine Blade Heat Transfer; 7) Bypass Transition Via Continuous Modes and Unsteady Effects on Film Cooling; 8) High Frequency Surface Heat Flux Imaging of Bypass Transition; 9) Skin Friction and Heat Flux Oscillations in Upstream Moving Wave Packets; 10) Transition Mechanisms and Use of Surface Roughness to Enhance the Benefits of Wake Passing in LP Turbines; 11) Transient Growth Approach to Roughness-Induced Transition; 12) Roughness- and Freestream-Turbulence-Induced Transient Growth as a Bypass Transition Mechanism; 13) Receptivity Calculations as a Means to Predicting Transition; 14) On Streamwise Vortices in a Curved Wall Jet and Their Effect on the Mean Flow; 15) Plasma Actuators for Separation Control of Low Pressure Turbine Blades; 16) Boundary-Layer Separation Control Under Low-Pressure-Turbine Conditions Using Glow-Discharge Plasma Actuators; 17) Control of Separation for Low Pressure Turbine Blades: Numerical Simulation; 18) Effects of Elevated Free-Stream Turbulence on Active Control of a Separation Bubble; 19) Wakes, Calming and Transition Under Strong Adverse Pressure Gradients; 20) Transitional Bubble in Periodic Flow Phase Shift; 21) Modelling Spots: The Calmed Region, Pressure Gradient Effects and Background; 22) Modeling of Unsteady Transitional Flow on Axial Compressor Blades; 23) Challenges in Predicting Component Efficiencies in Turbomachines With Low Reynolds Number Blading; 24) Observations on the Causal Relationship Between Blade Count and Developing Rotating Stall in a Four Stage Axial Compressor; 25) Experimental and Numerical Study of Non-Linear Interactions in Transonic Nozzle Flow; 26) Clocking Effects on a Modern Stage and One-Half Transonic Turbine; 27) DNS and LES of Transition on Turbine Blades; 28) The Use of Cellular Automata in Modeling the Transition; 29) Predicting Unsteady Buffet Onset Using RANS Solutions; 30) Transition Modelling With the SST Turbulence Model and an Intermittency Transport; and 31) Equation Workshop Summary Transcript
CASI
Turbomachinery; Unsteady Flow; Transition Flow; Flow Distribution

20040110905 Royal Inst. of Tech., Stockholm, Sweden
Experimental and Numerical Investigation of Transitional Flows as Affected by Passing Wakes
Fransson, Torsten; Bron, Olivier; Allegret-Bourdon, Davy; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 520-523; In English; See also 20040110902; No Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Transonic flows about streamlined bodies are strongly affected, particularly near the shock location, by unsteady excitations. Experimental and computational studies have shown that the unsteady pressure distribution along the surface of an airfoil or a cascade blade in unsteady transonic flow exhibits a significant unsteady pressure bulge near the shock location whose phase variation results from non-linear interaction between the mean and unsteady flows. The shock motion, and thus the pressure distribution along the surface, can be critical regarding to the self-exciting oscillations of the airfoil. The sharp rise in the unsteady pressure distribution was due to near-sonic velocity that acts as an acoustic blockage barrier preventing acoustic disturbances from propagating upstream. The present investigation focuses the analysis on the shock features. Experiments have been carried out in a simple 2D convergent divergent nozzle, using multichannel transient pressure measurements, surface oil flow and Schlieren. Comparisons were made with numerical simulations utilizing a three-

dimensional unsteady, compressible, Reynolds Averaged, Navier-Stokes solver.
Author
Transonic Flow; Wakes; Numerical Analysis; Nonlinearity; Wind Tunnel Tests; Streamlined Bodies

20040110906 Naval Academy, Annapolis, MD, USA
Active and Passive Flow Control on Low Pressure Turbine Airfoils
Volino, Ralph J.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 78-97; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Modern low-pressure turbine airfoils are subject to increasingly stronger pressure gradients as designers impose higher loading to improve efficiency and lower cost by reducing the number of airfoils in an engine. If the adverse pressure gradient on the suction side becomes strong enough, the boundary layer will separate. Separation bubbles, particularly those which fail to reattach, can result in a significant degradation of engine efficiency. The problem is particularly relevant in aircraft engines. Airfoils optimized to produce maximum power under takeoff conditions may still experience separation at cruise conditions, due to the thinner air and lower Reynolds numbers at altitude. An efficiency drop of 2% may occur between takeoff and cruise in large commercial transport engines, and the difference could be larger in smaller engines operating at higher altitudes. Needed is a means of controlling separation at low Re, without sacrificing the gains achieved at high Re. In the present study, passive and active flow control are applied to the suction surface boundary layer on an LP turbine airfoil. Experiments are conducted in a single passage cascade simulator. Reynolds numbers (based on exit velocity and suction surface length) from 25,000 to 300,000 are considered under both high (8% inlet) and low (0.5%) free-stream turbulence (FSTI) conditions. In the passive control experiments, thin rectangular bars are applied to the airfoil near the suction surface velocity peak. Bars that are sufficiently large immediately trip the boundary layer to turbulent and prevent separation. Smaller bars initially appear to have little or no effect, and the boundary layer separates. Some distance downstream, however, small disturbances induced by the bars induce transition in the shear layer over the separation bubble, causing reattachment to move upstream relative to its location in the unmodified flow. The cases with the shortened separation bubbles appear to have lower losses than those with the larger trips. Bars which produce optimal results at low Re, however, invariably cause higher losses at the highest Re, suggesting the possible benefit of active flow control. Active control is achieved using synthetic (oscillating, i.e. no net mass flow) vortex generator jets. An airfoil was constructed with a central cavity and a spanwise row of small holes extending from the cavity to the suction surface. The cavity is pulsed with a loudspeaker, causing jets to enter the boundary layer at a compound angle relative to the blade surface and the main flow. A single case has been documented to date with Re=25,000 and low FSTI. The separation bubble is completely eliminated, as shown through smoke visualization and animations of phase locked quantitative data. Ensemble averaged data (relative to the jet pulsing) show a turbulent patch moving down the blade after each outward jet pulse, followed by an extended 'calmed' period characterized by a thin, attached laminar boundary layer. Losses appear substantially lower than with passive control.
Derived from text
Airfoils; Free Flow; Low Pressure; Turbine Engines; Active Control; Subsonic Wind Tunnels

20040110908 Ohio State Univ., Columbus, OH, USA
Clocking Effects on a Modern Stage and One-Half Transonic Turbine
Dunn, Mike; Haldeman, Charlie; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 524-534; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper describes pressure measurements obtained for a modern one and one-half stage turbine. As part of the experimental effort, the position of the HPT vane was clocked relative to the downstream LPT vane to determine the influence of vane clocking on both the steady and unsteady pressure loadings on the LPT vane and the HPT blade. In addition, the axial location of the HPT vane relative to the HPT blade was changed to investigate the combined influence of vane/blade spacing and clocking on the unsteady pressure loading. Time-averaged and time-accurate surface-pressure results are presented for several spanwise locations on the vanes and blade. Results were obtained at four different HPT vane-clocking positions and at two different vane/blade axial spacings for three (of the four) clocking positions. For time-averaged results, the effect of clocking is small on the HPT blade and vane. The influence of clocking on the transition ducts and the LPT vane is slightly greater (on the order of 1%). Reduced HPT vane/blade spacing has a larger effect than clocking on the HPT vanes and blades (3%) depending upon the particular surface. Examining the data at blade passing and the first fundamental frequency, the effect of spacing does not produce a dramatic influence on the relative changes that occur between clocking positions. The results demonstrate that clocking and spacing effects on the surface pressure loading are very complex and may introduce

problems if the results of measurements or analysis made at one span or location in the machine are extrapolated to other sections.
Author
Pressure Measurement; Turbines; Supersonic Turbines; Ducted Flow

20040110909 Tel-Aviv Univ., Ramat-Aviv, Tel-Aviv, Israel
Effects of Elevated Free-Stream Turbulence on Active Control of a Separation Bubble
Ashpis, D., Technical Monitor; Halfon, E.; Nishri, B.; Seifert, A.; Wygnanski, I.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 392-406; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Effects of elevated free-stream turbulence (FST) on the natural and periodically excited separation bubbles were studied experimentally, due to the relevance of this flow to low-pressure turbine blades at low Reynolds numbers. A bubble was formed at the leading edge of a flat plate and the FST level was altered by placing a grid across the flow at different locations upstream of the plate. The mixing across the separated shear-layer, forming the free boundary of the bubble, increased due to the elevated FST and due to nominally two-dimensional periodic excitation, both flattening and shortening the bubble. Periodic excitation at frequencies that were at least an order of magnitude lower than those associated with the initial shear-layer instability, were very effective at low FST, because the amplitudes of the excitation frequency and its harmonic were amplified over the bubble. High frequency excitation (F+ 3, based on the length of the baseline low FST bubble) had a major effect close to the separation location, while farther downstream the excited fluctuations rapidly decayed in the reattachment region. Low frequency excitation, that generated waves comparable to the length of the unperturbed bubble (F+ 1) were less effective and their magnitude decayed at a slower rate downstream of reattachment. An increase in the level of the FST reduced the net effect of the periodic excitation on the mixing enhancement and subsequent reattachment process, probably due to a destructive interference between the nominally 2D excitation and the random (in space and time) FST, reducing the spanwise coherence and therefore the effectiveness of the current control strategy. However, even at the reduced effectiveness of 2D periodic excitation at elevated FST, it accelerated the reattachment process and the recovery rate of the reattached boundary layer, enhancing the boundary layer resistance to repeat separation and reducing its momentum loss further downstream.
Author
Turbulence Effects; Free Flow; Bubbles; Low Pressure; Low Reynolds Number; Turbine Blades

20040110911 Technische Univ., Berlin, Germany
Transitional Bubble in Periodic Flow Phase Shift
Talan, M.; Hourmouziadis, Jean; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 432-446; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

One particular characteristic observed in unsteady shear layers is the phase shift relative to the main flow. In attached boundary layers this will have an effect both on the instantaneous skin friction and heat transfer. In separation bubbles the contribution to the drag is dominated by the pressure distribution. However, the most significant effect appears to be the phase shift on the transition process. Unsteady transition behaviour may determine the bursting of the bubble resulting in an unrecoverable full separation. An early analysis of the phase shift was performed by Stokes for the incompressible boundary layer of an oscillating wall and an oscillating main flow. An amplitude overshoot within the shear layer as well as a phase shift were observed that can be attributed to the relatively slow diffusion of viscous stresses compared to the fast change of pressure. Experiments in a low speed facility with the boundary layer of a flat plate were evaluated in respect to phase shift. A pressure distribution similar to that on the suction surface of a turbomachinery aerofoil was superimposed generating a typical transitional separation bubble. A periodically unsteady mainflow in the suction type wind tunnel was introduced via a rotating flap downstream of the test section. The experiments covered a range of the three similarity parameters of momentum-loss-thickness Reynolds-number of 92 to 226 and Strouhal-number (reduced frequency) of 0.0001 to 0.0004 at the separation point, and an amplitude range up to 19 %. The free stream turbulence level was less than 1%
Derived from text
Bubbles; Transition Flow; Shear Layers; Boundary Layers; Heat Transfer

20040110912 Karlsruhe Univ., Germany

DNS and LES of Transition on Turbine Blades

Rodi, Wolfgang; Wissink, Jan; Michelassi, Vittorio; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 535-595; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

On turbine blades, a rich variety of transition mechanisms can be found. In the absence of disturbances of the oncoming flow, natural transition via - vortices was observed. In the presence of oncoming wakes, usually by-pass transition occurs with the location of transition moving back and forth on the blade surface. Under some conditions, especially at lower Reynolds numbers, transition occurs in a laminar separation bubble which can be suppressed by the periodically passing wakes. In low pressure turbines (LPT) the Reynolds numbers are relatively low so that, with the much increased computer resources available today, Direct Numerical Simulations (DNS) of the flow at operating conditions are possible, at least for the lower Re-range of interest, and also well-resolved Large-Eddy Simulations (LES) for the higher Re-range. In such simulations, the transition mechanisms can be studied in detail and the results can be used as basis for developing and testing less expensive RANS engineering calculation methods. In a German Research Foundation (DFG) project Unsteady periodic flow in turbomachinery such simulations are performed for unsteady transitional flow in turbine-related geometries, and an overview is given in the present contribution. Altogether three geometries are considered, two different LPT cascades with oncoming wakes generated by moving cylinders, and an idealized situation of a boundary layer in a converging-diverging channel with oscillating flow. In the latter case, the oscillating pressure gradient causes the boundary layer to alternately separate and re-attach; in the laminar separation bubble transition occurs and at some phases there is self-sustained turbulence. These complex processes were studied by DNS. For the T106 LPT cascade, DNS was carried out for a Reynolds number based on the approach flow velocity and the axial chord length of Re = 5.18 x 10(exp 4) with passing wakes generated upstream by moving cylinders. Also in this case, in the adverse pressure gradient region on the suction side, alternately laminar separation with transition and re-attachment (when the wakes pass) occurs. This flow was also simulated by LES on a coarser grid and similar results were obtained. For the same cascade the situation of the higher Reynolds number of Re = 1.48 x 10(exp 5) with passing wakes was calculated by LES. In this case there is no separation on the suction side and by-pass transition occurs which is induced by the passing wakes. For this flow the LES results are compared with the previous DNS results obtained by Wu and Durbin (J. Fluid Mech., 446, 2001). Preliminary LES were also carried for a different cascade at Re = 7.2 x 10(exp 4), again with oncoming wakes. These calculations will be extended to study the influence of passing wakes on the heat transfer to the blades, also by DNS. In the presentation, the transition mechanisms are discussed with aid of these simulation results and they are illustrated by animations.

Derived from text

Direct Numerical Simulation; Large Eddy Simulation; Turbine Blades; Oscillating Flow

20040110914 Department of the Air Force, Wright-Patterson AFB, OH, USA

High Frequency Surface Heat Flux Imaging of Bypass Transition

Anthony, Richard; Jones, T. V.; LaGraff, J. E.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 168-193; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A high-frequency surface heat flux imaging technique was employed in an investigation of bypass transition induced by freestream turbulence. Fundamental experiments were carried out at Oxford using high-density thin film arrays on a flat plate model. Bypass transition was induced by grid-generated turbulence with varying intensities of 2.3%, 3.6%, and 17% with a fixed integral length scale of approximately 12mm. Results show, under moderate freestream turbulence (Tu greater than 0.7%), enhanced heat flux streaks first appear elongated in the streamwise direction and originating near the leading edge. These are followed by a breakdown into streaky, subcritical turbulent spots at low Reynolds number. Under high freestream turbulence (Tu greater than 17%), temporal heat flux images show structures traveling within the boundary layer at a fraction of the freestream velocity with unsteady spanwise motion. Evidence suggests strong spanwise fluctuations in the freestream may force local, unsteady crossflow effects within the boundary layer. The temporal imaging technique allows us to study unsteady surface heat transfer in detail, and help elucidate the complex nature of transition in the high-disturbance environment of turbomachinery.

Author

Heat Flux; High Frequencies; Thin Films; Low Reynolds Number; Imaging Techniques; Free Flow

20040110915 Liverpool Univ., UK

Receptivity Calculations as a Means to Predicting Transition

Johnson, Mark W.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 277-300; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Previous experimental work at Liverpool has shown how bypass transition is preceded by the growth of near wall velocity fluctuations in the pre-transitional boundary layer. When these fluctuations reach a critical amplitude turbulent spots are initiated through transient local 3-d flow separations of the boundary later. At Minnowbrook IV recent work on the numerical prediction of these laminar fluctuations will be presented. The magnitude of the near wall velocity fluctuations depends on the local receptivity of the boundary layer to the freestream turbulence. In the work to be presented, the fluctuations are assumed to be fully 3-d viscid, but linear, perturbations to the steady flow. Fourier expansions are used to represent the fluctuating velocities and pressure in the spanwise and streamwise directions, which reduces the numerical problem to the solution of a family of ordinary differential equations. Fourth order finite differences are used for the discretisation and solutions are obtained using standard numerical techniques on a PC. The freestream turbulence is considered as a superposition of vortices of varying frequency and 3-d orientation. The overall receptivity of boundary layers to freestream turbulence simulated through the full spectra of vortex frequencies and orientations is also considered. The numerical results reproduce the experimental observations reasonably well, although at the lowest frequencies (wavelengths of 100 s of boundary layer thicknesses) the numerical calculations over predict the receptivity. The reasons for this discrepancy will be discussed in the presentation. The overall receptivity results are used to derive a predictive method for start of transition, which contains no empirical information. The predicted start of transition locations are similar to the Abu-Ghannam and Shaw correlation values, but the present method extends the adverse pressure gradient range beyond separation. Work currently in progress at Liverpool is extending the current numerical procedure to consider the receptivity of 3-d boundary layers and also of boundary layers on compliant surfaces. The primary objective of the work is to understand the underlying physics of transition in order to improve methods for its prediction.

Author (revised)

Turbulent Boundary Layer; Laminar Boundary Layer; Boundary Layer Transition; Free Flow

20040110916 NASA Glenn Research Center, Cleveland, OH, USA

Effects of Freestream Turbulence on Turbine Blade Heat Transfer

Boyle, Robert J.; Giel, Paul W.; Ames, Forrest E.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 134-151; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Experiments have shown that moderate turbulence levels can nearly double turbine blade stagnation region heat transfer. Data have also shown that turbine blade hear transfer is strongly affected by the scale of turbulence as well as its level. In addition to the stagnation region, turbulence is often seen to increase pressure surface heat transfer. This is especially evident at low to moderate Reynolds numbers. Vane and rotor stagnation region, and vane pressure surface heat transfer augmentation is often seen in a pre-transition environment. Rotor pressure surface augmentation is often seen in a relaminarized post-transition environment. Accurate predictions of transition and relaminarization are critical to accurately predicting blade surface heat transfer. An approach is described which incorporates the effects of both turbulence level and scale into a CFD analysis. The model for the effects of turbulence intensity and scale is derived from experimental data for cylindrical and elliptical leading edges. Results using this model are compared with experimental data for both vane and rotor geometries. There is a twofold purpose to these comparisons. One is to illustrate that using a model which includes the effects of turbulence length scale improves agreement with data. The second is to illustrate where improvements in the modeling are needed.

Author

Computational Fluid Dynamics; Heat Transfer; Turbine Blades; Turbulence; Free Flow

20040110917 Indian Inst. of Science, Bangalore, India

The Use of Cellular Automata in Modeling the Transition

Narasimha, Roddam; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 560-564; In English; See also 20040110902; No Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The lecture will describe recent developments in the author's group at Bangalore in research on the transition zone. It will in particular concentrate on two of these developments: 1) Asymptotic theories for analyzing the stability of nonparallel shear flows in compressible and three-dimensional flows; and 2) A computer simulation of the transition zone using cellular

automaton ideas, with emphasis on subtransitions. The implications of these developments for transition zone research will be discussed in the lecture. The work has been carried out with Rama Govindarajan and S Sanjeeva Rao.
Derived from text
Cellular Automata; Transition Flow; Mathematical Models; Automata Theory

20040110918 Arizona Univ., Tucson, AZ, USA
On Streamwise Vortices in a Curved Wall Jet and Their Effect on the Mean Flow
Wygnanski, Israel; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 301-323; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Wall jets are often used to enhance the heat and mass transfer from a surface, to provide super-circulation and to delay boundary-layer separation from lifting surfaces. A wall jet, flowing over the outer surface of a circular cylinder has the unique ability to wrap itself around the surface detaching itself at a direction that is opposite to the nozzle from which the jet emanated. In the example shown, a jet of momentum J, emanating to the right from a slot located on top of the cylinder turns around it before separating to the left at the bottom of this cylinder. The turning of the flow generates a low pressure region on the right hand surface creating a side force that is almost equal to twice the value of J. This force is currently used to prevent the autorotation on a NOTAR type of a single rotor helicopter eliminating the need for a tail-rotor. The existence of longitudinal vortices in a turbulent wall jet that flows over a convex surface was shown earlier by Neuendorf et al. The spanwise wavelength of these vortices corresponds to the local width of the wall suggesting that they are a product of a centrifugal instability. The growth of these vortices in the direction of streaming is attributed mainly to vortex amalgamation, but they also individually, though weakly amplify. This amplification is attributed in part to a secondary instability resulting from distortions in the mean velocity field. Therefore there is a great disparity in the turbulence level and its structure between the curved and straight wall jets. Since the longitudinal vortices meander in span, the mean flow is two dimensional. In order that the streamwise vortices will be initiated at preferred spanwise locations without hindering their natural meander and instabilities, a row of micro vortex generators (muVGs) was placed on the outer lip of the nozzle. The VGs are no more than wires (needles) having a diameter of 0.6 mm that protruded into the nozzle flow a distance of 0.4 mm only. The size of the micro VG was so selected as not to impede the growth of the streamwise vortices in the direction of streaming. It was an arduous cut and try process that eventually bore fruit. It is indicated that flow structures triggered by differently spaced muVGs(lambda sub i/b varied by a factor of 3) evolve into the approximately the same spanwise wavelength far downstream. The process of amalgamation and its effects on the flow will be discussed.
Derived from text
Vortices; Wall Jets; Contours; Turbulent Jets; Laminar Flow

20040110919 Cambridge Univ., Cambridge, UK
Transition Mechanisms and Use of Surface Roughness to Enhance the Benefits of Wake Passing in LP Turbines
Stieger, R. D.; Vera, M.; Zhang, X. F.; Hodson, H. P.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 216-242; In English; See also 20040110902
Contract(s)/Grant(s): G4RD-CT-2001-00628; GR/L96660/01; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper is concerned with the interaction of upstream wakes with the low Reynolds number boundary layer on the suction side of LPT airfoils. It is this interaction that has led to the design of LPT airfoils with increased levels of lift. The main aim of the paper is to describe, in detail, the transition mechanisms that result from the interaction of the wakes with the separation bubble that exists on the suction side of modern airfoils. This transition results in a profile loss that is lower than would otherwise be the case for high lift and ultra high lift airfoils. Comparisons are made between the results from high speed and low speed moving bar cascades to confirm the validity of the mechanisms described. Finally, it is shown that by using surface roughness, it is possible to further reduce the profile loss of these airfoils. The first part of the paper justifies the use of large-scale low speed research rigs. A comparison is made between equivalent low speed and a high speed cascades to demonstrate the validity of low speed testing. A detailed experimental investigation into the interaction of a wake and a separation bubble on the rear suction surface of a highly loaded low-pressure turbine blade is then described. A two-dimensional Laser Doppler Anemometer has been used to measure the convection of representative wakes through a large scale, low speed turbine cascade fitted with the T106A profile. These measurements confirm that the wake convection is kinematic and reveal that the results of wake stretching and bowing result, respectively, in a decrease and an increase in the turbulence energy of the flow. Thus, while the mean level of turbulence energy is largely unchanged, significant variations exist within the unsteady wakes. Boundary layer measurements, also made with 2D LDA and using PIV, reveal the transition

mechanism. Prior to the arrival of the wake, the boundary layer profiles in the separation region are inflexional. The perturbation of the separated shear layer caused by the convecting wake causes an inviscid Kelvin-Helmholtz rollup of the shear layer. This results in the breakdown of the laminar shear layer and a rapid wake-induced transition in the separated shear layer. The vortices also produce a series of high frequency large amplitude pressure perturbations. These are also found to exist in the high speed moving bar cascade.
Author (revised)
Turbines; Surface Roughness; Wakes; Separated Flow

20040110922 Case Western Reserve Univ., Cleveland, OH, USA
Roughness- and Freestream-Turbulence-Induced Transient Growth as a Bypass Transition Mechanism
White, Edward B.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 256-276; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Laminar-to-turbulent transition of attached turbomachinery boundary layers has been categorized as being either natural or bypass transition. Natural transition refers to the exponential growth of low-amplitude Tollmien Schlichting (TS) waves leading to three dimensionality and breakdown under low-disturbance conditions; bypass transition is the process that occurs under high-disturbance conditions. While this is an acceptable phenomenological distinction, use of the term bypass hinders transition prediction efforts because it does not refer to a specific disturbance growth mechanism whose behavior can be explained using the physics of that mechanism. A more useful approach to transition scenarios that do not follow the TS path is to identify the physical mechanism leading to receptivity, growth, and breakdown because understanding these features is essential to accurate transition prediction. One example of progress in this area is the development of transient-growth theory. Transient growth is a nonmodal growth mechanism through which certain disturbances undergo a brief but significant period of algebraic growth and then exponential decay. Unlike modal instabilities such as TS waves, the behavior (e.g., growth rates) and not just the amplitude of transient disturbances is a strong function of the initial disturbances conditions and this makes the receptivity problem for transient growth especially important. Theoretical work over the past decade has not addressed receptivity and has instead worked with so-called optimal initial disturbances that lead to the largest transient growth over a defined length or time. The finding is that optimal disturbances are stationary streamwise vortices that produce streamwise streaks downstream. Despite the fact that optimal disturbance theories do not address receptivity, these results are quite promising as a means of explaining some cases of bypass transition because the optimal streaks bear a striking resemblance to Klebanoff modes produced by freestream turbulence or distributed surface roughness. In the context of turbomachinery transition it is significant that these results have been obtained using linearized equations and that non-TS bypass may not be restricted to high-amplitude disturbances; the frequencies and wavenumbers of the initial disturbances may play a more important role than amplitudes alone. The present experimental work provides data that quantifies the effects of roughness-induced transient growth in zero-pressure-gradient boundary layers and continuing work will address freestream turbulence, pressure gradients, and surface curvature. The data obtained to date shows that transient growth exists but that there are significant differences between optimal-disturbance predictions and disturbances that can be realized experimentally. The findings also give a preliminary indication of how transient disturbances scale with roughness amplitude but these results do not agree with some recent receptivity calculations. Overall, the results highlight that although computational tools are already capable of modeling the transient growth of particular small-amplitude disturbances, additional effort will be needed to understand how roughness and freestream-turbulence lead to transient growth in realistic situations and how transition will be affected in those cases.
Derived from text
Bypasses; Surface Roughness; Free Flow; Turbomachinery; Pressure Gradients; Transition Flow; Turbulent Flow

20040110923 Case Western Reserve Univ., Cleveland, OH, USA
Transient Growth Approach to Roughness-Induced Transition
Reshotko, Eli; Tumin, Anatoli; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 243-255; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Surface roughness can have a profound effect on boundary layer transition. However, the mechanisms responsible for transition with three-dimensional distributed roughness have been elusive. Various T-S based mechanisms have been investigated in the past but have been shown not to be applicable. More recently the applicability of transient growth theory to roughness induced transition has been studied. Transient growth arises through the coupling between slightly damped, nearly streamwise Orr-Sommerfeld and Squire modes leading to algebraic growth followed by exponential decay outside the

T-S neutral curve. A weak transient growth can also occur for two-dimensional or axisymmetric modes since the Orr-Sommerfeld operator (also its compressible counterpart) is not self-adjoint, therefore its eigenfunctions are not strictly orthogonal. A model for roughness-induced transition is developed that makes use of computational results based on the spatial transient growth theory. In all cases, Re(sub theta,tr) is approx. (k/theta)(exp -1). For a flat plate in incompressible flow, the result reduces to U(sub e)k/nu = const. The data of Feindt suggest that the constant is 120. For a compressible flat plate with T(sub w)/T(sub aw) \g 0.75, the constant is a function of surface temperature level but essentially independent of Mach number. For cold walls, the constant is sensitive to both Mach number and surface temperature level. Nosetip transition is the early transition that takes place on spherical nosetips of entry vehicles. It occurs in the subsonic region behind the bow shock wave, a region of highly favorable pressure gradient that is T-S stable, but amenable to transient growth. For nosetip transition, the resulting transition relations reproduce the trends of the Reda and PANT data and account for the separate roles of roughness and surface temperature level on the transition behavior. A correlating relation for both the PANT and the Reda data is Re(sub theta,tr) = 180 (k/theta)(exp -1)(T(sub e)/2T(sub w))(exp -1.27) or alternatively U(sub e)k/nu(sub e) = 180 (2Tw/Te)(exp 1.27) From these examples, it is evident that transient growth is a very promising explanation for roughness-induced transition. This work is supported by the U.S. Air Force Office of Scientific Research.
Author
Surface Roughness; Boundary Layer Transition

20040110924 Notre Dame Univ., IN, USA
Plasma Actuators for Separation Control of Low Pressure Turbine Blades
Huang, J.; Corke, T.; Thomas, F.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 324-348; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This work involves the documentation and control of flow separation that occurs over turbine blades in the low-pressure turbine (LPT) stage at he low Reynolds numbers typical of high altitude cruise. We utilize a specially constructed linear cascade that is designed to study the flow field over a generic LPT cascade consisting of Pratt & Whitney 'Pak B' shaped blades. The center blade in the cascade is instrumented to measure the surface pressure coefficient distribution. Optical access allows LDV measurements for boundary layer profiles. Experimental conditions were chosen to give a range of chord Reynolds numbers from 10K to 100K, and a range of free-stream turbulence levels from u prime/U(sub proportional to) = 0.08% to 2.85%. The surface pressure measurements were used to define a region of separation and re-attachment that depend on the free-stream conditions. The location of separation was found to be relatively insensitive to the experimental conditions. However, the re-attachment location was very sensitive to the turbulence level and Reynolds number. Excellent agreement was found between the measured pressure distributions and predictions from Euler simulations. Separation control was performed using a single plasma actuator that is placed at different chord locations, upstream of the separation line. The actuator is designed to produce a steady 2-D jet which is locally parallel to the blade surface. This is intended to add momentum to the near-wall boundary layer. Re-attachment occurred in all cases. The amplitude level of te actuator was varied to determine its effect on the re-attachment location.
Author
Actuators; Low Pressure; Plasma Control; Turbine Blades; Separated Flow

20040110926 NASA Glenn Research Center, Cleveland, OH, USA
Current Issues in Unsteady Turbomachinery Flows
Povinelli, Louis; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 1-25; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Among the numerous causes for unsteadiness in turbo machinery flows are turbulence and flow environment, wakes from stationary and rotating vanes, boundary layer separation, boundary layer/shear layer instabilities, presence of shock waves and deliberate unsteadiness for flow control purposes. These unsteady phenomena may lead to flow-structure interactions such as flutter and forced vibration as well as system instabilities such as stall and surge. A major issue of unsteadiness relates to the fact that a fundamental understanding of unsteady flow physics is lacking and requires continued attention. Accurate simulations and sufficient high fidelity experimental data are not available. The Glenn Research Center plan for Engine Component Flow Physics Modeling is part of the NASA 21st Century Aircraft Program. The main components of the plan include Low Pressure Turbine National Combustor Code. The goals, technical output and benefits/impacts of each element are described in the presentation. The specific areas selected for discussion in this presentation are blade wake interactions, flow control, and combustor exit turbulence and modeling. experimental and computational databases and models for flow control,

data for Reynolds Stress modeling and model development and combustor spectra measurement and an LES version of the Derived from text

Wakes; Turbomachinery; Boundary Layer Separation; Turbulence Models

20040110930 Leicester Univ., UK

Wakes, Calming and Transition Under Strong Adverse Pressure Gradients

Gostelow, Paul; Thomas, Richard; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 407-431; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A flat plate under a strong adverse pressure gradient was subjected to wakes generated by rods moving transversely upstream of the leading edge. The results highlight the interaction between incoming wakes and the undisturbed boundary layer, which features a long and thin laminar separation bubble. Wakes have been presented individually and in pairs at different wake spacing intervals; in this way it is proposed to investigate wake interaction effects in more detail. Each wake provoked a vigorous turbulent patch, resulting in the instantaneous collapse of the separation bubble. This was followed by a very strong and stable calmed region. In the undisturbed flow the bubble exhibited a natural growth of Tollmien-Schlichting waves. The bubble was closed by a short, but conventional, transition region that could be characterized by the universal intermittency distribution. The data gathered extend our transition length prediction capability well into the laminar separation region.

Author

Wakes; Flat Plates; Boundary Layers; Pressure Gradients

20040110932 Tasmania Univ., Hobart, Australia

Modeling of Unsteady Transitional Flow on Axial Compressor Blades

Walker, G. J.; Henderson, A. D.; Hughes, J. D.; Coupland, J.; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 454-475; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Engineering predictions of unsteady transitional flow on C4-section axial compressor blades are obtained with linked UNSFLO and PUIM (Prescribed Unsteady Intermittency Method) calculations. The aim is to provide simplified models of wake-disturbed flow suitable for implementation in iterative design calculations for axial turbomachine blades. The UNSFLO code of Giles solves the unsteady thin-layer Navier-Stokes equations for the viscous flow near a blade surface and treats the rest of the flow domain as inviscid. The effects of upstream wakes are modelled by imposing inviscid wake profiles that approximate the real wake profiles on the inflow boundary. Viscous diffusion and dissipation due to turbulence within the wakes is ignored. Previous work by Coupland, using the PUIM model of Hodson, employed a steady flow solution from UNSFLO together with a time-varying free-stream turbulence level approximating that imposed by passing upstream wakes to estimate the unsteady intermittency distribution, (x,t), produced by fluctuations of the laminar-turbulent interface within the blade boundary layer in the wake-disturbed flow. Effects of fluctuating boundary layer thickness and local pressure gradient parameter on stability and transition were ignored in computing this approximate distribution. An unsteady UNSFLO calculation with (x,t) prescribed from this model was then used to predict the unsteady viscous flow behavior around the blade. The present paper reports on current attempts to extend this approach by using an unsteady UNSFLO calculation to include first-order estimates for the effect of potential flow (pressure field) interactions on boundary layer stability in determining (x,t). Results of the linked UNSFLO and PUIM calculations are compared with experimental data of Hughes for the unsteady intermittency distribution obtained from surface hot film measurements for a range of blade loading and Reynolds number. Additional comparisons are made with hot-wire observations of downstream blade wake thickness fluctuations produced by the passage of upstream blade wakes. The effect of using different transition onset and transition length prediction methods is examined and outstanding problems are discussed.

Author

Unsteady Flow; Transition Flow; Compressor Blades; Axial Flow; Mathematical Models

20040110933 Stanford Univ., Stanford, CA, USA

Bypass Transition Via Continuous Modes and Unsteady Effects on Film Cooling

Durbin, Paul; Medic, Gorazd; Zaki, Tamer; Minnowbrook IV: 2003 Workshop on Transition and Unsteady Aspects of Turbomachinery Flows; August 2004, pp. 152-167; In English; See also 20040110902; No Copyright; Avail: CASI; A03, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In the informal spirit of this workshop, I will present research that is currently in progress in two areas. The first is bypass transition. We have pursued the idea that aspects of this phenomenon can be characterized by the continuous modes of the Orr-Sommerfeld equation. At low frequency, these eigenfunctions penetrate into the boundary layer; at higher frequency they are expelled by the mean shear. We characterize the degree of penetration by computing a coupling coefficient between Orr-Sommerfeld and Squires modes. Penetrating modes produce wall streaks, but do not transition; non-penetrating modes are innocuous by themselves. Transition occurs when these modes interact. DNS has been used to study these processes. The modal content is set at the inlet and non-linear evolution is simulated. When only penetrating modes are included, wall streaks form, but no not transition within the flow domain. Penetrating and non-penetrating modes seem to be needed for transition to occur. Pressure gradient effects on transition are also being studied by DNS. The second topic is the effects of natural and forced unsteadiness on trailing edge film cooling. Experiments show that film effectiveness is far less than that predicted by steady CFD. Natural unsteadiness (vortex shedding) accounts for only a small part of the discrepancy. Periodic forcing reproduces the levels of effectiveness seen experimentally. This might correspond to incident wakes, or other ambient disturbances, in the engine environment. At present, this work is in the vein of a conceptual study: it is not entirely clear how our computations bear on practical prediction methods. An exploration of flow patterns and frequency spectra provides an understanding of how unsteady perturbations ultimately influence surface heat transfer. Various blowing ratios, in the vicinity of unity, are considered. These computational observations will be described in my presentation.
Author
Bypasses; Transition Layers; Unsteady Flow; Film Cooling; Edges; Computational Fluid Dynamics

20040110935 NASA Langley Research Center, Hampton, VA, USA
Application of Doppler Global Velocimetry to Supersonic Flows
Meyers, James F.; [1996]; 21 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The design and implementation of Doppler Global Velocimetry (DGV) for testing in the Langley Unitary Plan Wind Tunnel is presented. The discussion begins by outlining the characteristics of the tunnel and the test environment, with potential problem areas highlighted. Modifications to the optical system design to implement solutions for these problems are described. Since this tunnel entry was the first ever use of DGV in a supersonic wind tunnel, the test series was divided into three phases, each with its own goal. Phase I determined if condensation provided sufficient scattered light for DGV applications. Phase II studied particle lag by measuring the flow about an oblique shock above an inclined flat plate. Phase III investigated the supersonic vortical flow field above a 75-degree delta wing at 24-degrees angle of attack. Example results from these tests are presented.
Author
Supersonic Flow; Velocity Measurement; Supersonic Wind Tunnels; Wind Tunnel Tests; Systems Engineering

20040110942 NASA Langley Research Center, Hampton, VA, USA
A Method for the Constrained Design of Natural Laminar Flow Airfoils
Green, Bradford E.; Whitesides, John L.; Campbell, Richard L.; Mineck, Raymond E.; [1996]; 11 pp.; In English; 14th AIAA Applied Aerodynamics Conference, 17-20 Jun. 1996, New Orleans, LA, USA
Report No.(s): AIAA Paper 96-2502; Copyright; Avail: CASI; A03, Hardcopy

A fully automated iterative design method has been developed by which an airfoil with a substantial amount of natural laminar flow can be designed, while maintaining other aerodynamic and geometric constraints. Drag reductions have been realized using the design method over a range of Mach numbers, Reynolds numbers and airfoil thicknesses. The thrusts of the method are its ability to calculate a target N-Factor distribution that forces the flow to undergo transition at the desired location; the target-pressure-N-Factor relationship that is used to reduce the N-Factors in order to prolong transition; and its ability to design airfoils to meet lift, pitching moment, thickness and leading-edge radius constraints while also being able to meet the natural laminar flow constraint. The method uses several existing CFD codes and can design a new airfoil in only a few days using a Silicon Graphics IRIS workstation.
Author
Computational Fluid Dynamics; Laminar Flow Airfoils; Automatic Control; Iteration; Aircraft Design

20040110958 Maryland Univ., College Park, MD, USA
Interaction of a Boundary Layer with a Turbulent Wake
Piomelli, Ugo; [2004]; 31 pp.; In English
Contract(s)/Grant(s): NAG1-2285; Copyright; Avail: CASI; A03, Hardcopy

The objective of this grant was to study the transition mechanisms on a flat-plate boundary layer interacting with the wake of a bluff body. This is a simplified configuration presented and designed to exemplify the phenomena that occur in multi-element airfoils, in which the wake of an upstream element impinges on a downstream one. Some experimental data is available for this configuration at various Reynolds numbers. The first task carried out was the implementation and validation of the immersed-boundary method. This was achieved by performing calculations of the flow over a cylinder at low and moderate Reynolds numbers. The low-Reynolds number results are discussed, which is enclosed as Appendix A. The high-Reynolds number results are presented in a paper in preparation for the Journal of Fluid Mechanics. We performed calculations of the wake-boundary-layer interaction at two Reynolds numbers, Re approximately equal to 385 and 1155. The first case is discussed and a comparison of the two calculations is reported. The simulations indicate that at the lower Reynolds number the boundary layer is buffeted by the unsteady Karman vortex street shed by the cylinder. This is shown: long streaky structures appear in the boundary layer in correspondence of the three-dimensionalities in the rollers. The fluctuations, however, cannot be self-sustained due to the low Reynolds-number, and the flow does not reach a turbulent state within the computational domain. In contrast, in the higher Reynolds-number case, boundary-layer fluctuations persist after the wake has decayed (due, in part, to the higher values of the local Reynolds number Re achieved in this case); some evidence could be observed that a self-sustaining turbulence generation cycle was beginning to be established. A third simulation was subsequently carried out at a higher Reynolds number, Re=3900. This calculation gave results similar to those of the Re=l155 case. Turbulence was established at fairly low Reynolds number, as a consequence of the high level of the free-stream perturbation. An instantaneous flow visualization for that case is shown. A detailed examination of flow statistics in the transitional and turbulent regions, including the evolution of the turbulent kinetic energy (TKE) budget and frequency spectra showed the formation and evolution of turbulent spots characteristic of the bypass transition mechanism. It was also observed that the turbulent eddies achieved an equilibrium, fully developed turbulent states first, as evidenced by the early agreement achieved by the terms in the TKE budget with those observed in turbulent flows. Once a turbulent Reynolds stress profile had been established, the velocity profile began to resemble a turbulent one, first in the inner region and later in the outer region of the wall layer. An extensive comparison of the three cases, including budgets, mean velocity and Reynolds stress profiles and flow visualization, is included. The results obtained are also presented.
Derived from text
Flat Plates; Turbulent Wakes; Turbulent Boundary Layer; Fluid Mechanics

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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*.

20040095884 Naval Research Lab., Washington, DC
Environmental Security Technology Certification Program (ESTCP), Technology Demonstration Plan, MTADS Airborne and Vehicular Survey of Target S1 at Isleta Pueblo, Albuquerque, NM, 17 February - 2 March, 2003
Mar. 31, 2004; 129 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-200031
Report No.(s): AD-A425190; No Copyright; Avail: CASI; A07, Hardcopy

Buried unexploded ordnance, UXO, is one of the Department of Defense' s most pressing environmental problems. Not limited to active ranges and bases, UXO contamination is present at DOD sites that are dormant and in areas adjacent to military ranges that are under the control of other government agencies and the private sector. Traditional methods for buried UXO detection, characterization, and remediation are laborintensive, slow and inefficient. Typical detection and characterization methods rely on handheld detectors operated by explosive ordnance disposal (EOD) technicians who slowly walk across the survey area. This process has been documented as inefficient and marginally effective.1 In addition, a large portion, approaching 70% in some cases, of the total budget of a typical remediation effort is spent on digging targets that do not turn out to be ordnance. The Environmental Security Technology Certification Program, ESTCP, has supported the Naval Research Laboratory in the development of the Multi- sensor Towed Array Detection System, MTADS, to address these deficiencies. The MTADS incorporates both cesium vapor full- field magnetometers and pulsed-induction sensors in linear arrays that are towed over survey sites by an all-terrain vehicle. Sensor positioning is provided by state-of-the-art Real Time Kinematic (RTK) GPS receivers. The survey data acquired by MTADS are preprocessed using tools from the Geosoft Oasis montaj suite and then targets are analyzed using an NRL-developed Data Analysis System, DAS. The DAS was designed to

locate, identify and categorize all military ordnance at its maximum self-burial depth. It is efficient and simple to operate by relatively untrained personnel. The performance of the MTADS has been demonstrated at a number of prepared sites and live ranges over the past five years.2-12 It can detect and locate ordnance with accuracies on the order of 15 cm.5
DTIC
Aerial Reconnaissance; Ammunition; Certification; Explosives Detection; Project Planning; Security; Targets

20040095885 Naval Research Lab., Washington, DC
MTADS Airborne and Vehicular Survey of Target S1 at Isleta Pueblo, Albuquerque, NM, 17 February-2 March 2003
Nelson, H. H.; Wright, David; Furuya, Tom; McDonald, J. R.; Khadr, Nagi; Mar. 31, 2004; 56 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W74RDV21794099
Report No.(s): AD-A425191; NRL/MR/6110--04-8764; No Copyright; Avail: CASI; A04, Hardcopy

In February 2003, the Naval Research Laboratory demonstrated the Multi-sensor Towed Array Detection System (MTADS) vehicular and airborne magnetometer systems on the Pueblo of Isleta, near Albuquerque, NM. The demonstration consisted of two overlapping surveys. First, a vehicular magnetometery survey of 100 acres near the previously identified bull s eye, S1. Targets were expected to be M38 and BDU-33 practice bombs and an array of ordnance emplaced by the Army Engineering R&D Center at the direction of the ESTCP Program Office. Second, an airborne magnetometry survey of ^1500 acres around the target to include the vehicular area. Six hundred ninety targets were selected for remediation by UXO technicians. Each of the remediated items was characterized, photographed, and located by GPS re-survey. Using the results of this remediation, we develop probability of detection statistics for each of the two MTADS systems, derive information about location accuracy, and examine the classification performance of the two systems.
DTIC
Aerial Reconnaissance; Ammunition; Targets

20040095887 Helber Hastert and Fee Planners, Inc., Honolulu, HI
Environmental Assessment: Security Gate Improvements NCTAMS PAC Wahiawa, O'ahu, Hawaii
Caplan, Faith; Fee, Thomas A.; Jan. 2004; 49 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N62742-99-D-1808; Proj-P624
Report No.(s): AD-A425099; No Copyright; Avail: CASI; A03, Hardcopy

The Department of the Navy prepared an Environmental Assessment for Security Gate Improvements at the Naval Computer and Telecommunications Area Master Station Pacific (NCTAMS PAC), Wahiawa, Oahu, Hawaii. The Proposed Action is to construct Anti-Terrorism Force Protection improvements to maintain positive entry control at the NCTAMS PAC main gate Entry Control Point. The Proposed Action involves construction of a new Pass and Identification Office and new parking area, separate vehicle search area, utility improvements and fencing, and the acquisition of the fee interest in approximately 26.1 acres (ac)(10.6 hectares(ha)) of land from two adjacent landowners, Dole Foods Inc. and the State of Hawaii. Based on information gathered during the preparation of the Environmental Assessment, the Navy finds that the proposed Security Gate Improvements will not significantly impact human health or the environment.
DTIC
Security; Terrorism

20040095910 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Microshutters Arrays for the JWST Near Infrared Spectrometer
Moseley, Harvey; Arendt, R.; Boucarut, Ray; Jhabvals, Murzy; King, Todd; Kutyrev, Alexander; Li, Mary; Silverberg, Robert; Rapchun, David; [2004]; 2 pp.; In English; SPIE Conference, 19-25 Jun. 2004, Glasgow, Scotland, UK; No Copyright; Avail: Other Sources; Abstract Only

The Near Infrared Spectrograph (NIRSpec) for the James Webb Space Telescope (JWST) is an essential instrument for measuring the number and density evolution of galaxies following the epoch of initial formation. The NIRSpec is a multi-object spectrograph, allowing simultaneous observation of more than 100 candidate high redshift galaxies. A critical element of the instrument is the programmable field selector, the Microshutter Array. The system consists of four 175 x 384 arrays of individually openable shutters, close packed on a 100 x 200 micron pitch, which allow selection of over 200 candidate objects over the 3 min x 3 min field of the NIRSpec. We will describe the development, production, and test of this critical element of the NIRSpec.
Author
Spectrographs; Infrared Spectrometers; Shutters; Arrays

20040095925 NASA Langley Research Center, Hampton, VA, USA

Instantaneous Doppler Global Velocimetry Measurements of a Rotor Wake: Lessons Learned

Meyers, James; Fleming, Gary A.; Gorton, Susan Althoff; Berry, John D.; [1998]; 25 pp.; In English; 9th International Symposium on Applications of Laser Techniques to Fluid Mechanics, 13-16 Jul. 1998, Lisbon, Portugal; No Copyright; Avail: CASI; A03, Hardcopy

A combined Doppler Global Velocimetry (DGV) and Projection Moir Interferometry (PMI) investigation of a helicopter rotor wake flow field and rotor blade deformation is presented. The three-component DGV system uses a single-frequency, frequency-doubled Nd:YAG laser to obtain instantaneous velocity measurements in the flow. The PMI system uses a pulsed laser-diode bar to obtain blade bending and twist measurements at the same instant that DGV measured the flow. The application of pulse lasers to DGV and PMI in large-scale wind tunnel applications represents a major step forward in the development of these technologies. As such, a great deal was learned about the difficulties of using these instruments to obtain instantaneous measurements in large facilities. Laser speckle and other image noise in the DGV data images were found to be traceable to the Nd:YAG laser. Although image processing techniques were used to virtually eliminate laser speckle noise, the source of low-frequency image noise is still under investigation. The PMI results agreed well with theoretical predictions of blade bending and twist.

Author

Doppler Radar; Velocity Measurement; Interferometry; Wakes; Rotary Wings; Image Processing

20040105613 NASA Langley Research Center, Hampton, VA, USA, Army Research Lab., Hampton, VA, USA

Nondestructive Evaluation (NDE) Results on Sikorsky Aircraft Survivable Affordable Reparable Airframe Program (SARAP) Samples

Zalameda, Joseph N.; Anastasi, Robert F.; Madaras, Eric I.; August 2004; 40 pp.; In English

Contract(s)/Grant(s): DAAH10-02-2-0001; WU 23-762-55-TF

Report No.(s): NASA/TM-2004-213235; ARL-TR-3130; L-19014; No Copyright; Avail: CASI; A03, Hardcopy

The Survivable, Affordable, Reparable Airframe Program (SARAP) will develop/produce new structural design concepts with lower structural weight, reduced manufacturing complexity and development time, increased readiness, and improved threat protection. These new structural concepts will require advanced field capable inspection technologies to help meet the SARAP structural objectives. In the area of repair, damage assessment using nondestructive inspection (NDI) is critical to identify repair location and size. The purpose of this work is to conduct an assessment of new and emerging NDI methods that can potentially satisfy the SARAP program goals.

Author

Airframes; Nondestructive Tests; Sikorsky Aircraft; Structural Design; Ultrasonics; Lamb Waves

20040110411 NASA Langley Research Center, Hampton, VA, USA

Retinex Image Processing: Improved Fidelity To Direct Visual Observation

Jobson, Daniel J.; Rahman, Zia-Ur; Woodell, Glenn A.; [1996]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Recorded color images differ from direct human viewing by the lack of dynamic range compression and color constancy. Research is summarized which develops the center/surround retinex concept originated by Edwin Land through a single scale design to a multi-scale design with color restoration (MSRCR). The MSRCR synthesizes dynamic range compression, color constancy, and color rendition and, thereby, approaches fidelity to direct observation.

Author

Visual Observation; Image Processing; Color Vision

20040110422 NASA Langley Research Center, Hampton, VA, USA

Development of the Lidar Atmospheric Sensing Experiment (LASE): An Advanced Airborne DIAL Instrument

Moore, Alvah S., Jr.; Brown, Kevin E.; Hall, William M.; Barnes, James C.; Edwards, William C.; Petway, Larry B.; Little, Alan D.; Luck, William S., Jr.; Jones, Irby W.; Antill, Charles W., Jr., et al.; [1997]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The Lidar Atmospheric Sensing Experiment (LASE) Instrument is the first fully-engineered, autonomous Differential Absorption Lidar (DIAL) System for the measurement of water vapor in the troposphere (aerosol and cloud measurements are included). LASE uses a double-pulsed Ti:Sapphire laser for the transmitter with a 30 ns pulse length and 150 mJ/pulse. The laser beam is 'seeded' to operate on a selected water vapor absorption line in the 815-nm region using a laser diode and an onboard absorption reference cell. A 40 cm diameter telescope collects the backscattered signals and directs them onto two

detectors. LASE collects DIAL data at 5 Hz while onboard a NASA/Ames ER-2 aircraft flying at altitudes from 16-21 km. LASE was designed to operate autonomously within the environment and physical constraints of the ER-2 aircraft and to make water vapor profile measurements across the troposphere to better than 10% accuracy. LASE has flown 19 times during the development of the instrument and the validation of the science data. This paper describes the design, operation, and reliability of the LASE Instrument.
Author
Atmospheric Sounding; Differential Absorption Lidar; Airborne Equipment; Water Vapor; Measurement; Troposphere

20040110428 NASA Langley Research Center, Hampton, VA, USA
System Wide Joint Position Sensor Fault Tolerance in Robot Systems Using Cartesian Accelerometers
Aldridge, Hal A.; Juang, Jer-Nan; [1997]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Joint position sensors are necessary for most robot control systems. A single position sensor failure in a normal robot system can greatly degrade performance. This paper presents a method to obtain position information from Cartesian accelerometers without integration. Depending on the number and location of the accelerometers. the proposed system can tolerate the loss of multiple position sensors. A solution technique suitable for real-time implementation is presented. Simulations were conducted using 5 triaxial accelerometers to recover from the loss of up to 4 joint position sensors on a 7 degree of freedom robot moving in general three dimensional space. The simulations show good estimation performance using non-ideal accelerometer measurements.
Author
Fault Tolerance; Robot Sensors; Degrees of Freedom

20040110478 Time Domain Systems, Inc., Huntsville, AL
MOUT Through the Wall Surveillance Technology Development
White, Bob; Jun. 2004; 175 pp.; In English
Contract(s)/Grant(s): F30602-01-C-0085; Proj-R621
Report No.(s): AD-A425283; AFRL-IF-RS-TR-2004-155; No Copyright; Avail: CASI; A08, Hardcopy

The objective of this effort was to develop a handheld impulse radar that would detect the presence of human beings through walls in a military operations and urbanized terrain environment. Particular emphasis was placed on minimizing the weight of the unit so that it conformed to an overall ensemble. The completed unit was then submitted to testing. Areas of testing conducted included system testing, EMI/EMS testing, and temperature and humidity testing. System testing was designed to determine the overall performance of the unit, including its ability to detect objects through walls. EMI/EMS testing measured both unintentional and intentional electromagnetic emissions from the radar and its susceptibility to electromagnetic radiation. Temperature and humidity testing determined the radar's ability to be stored and to operate over widely varying environmental conditions. A set of 119 requirements was created from the requirements of the Statement Of Work (SOW), including detailed performance of detection of moving objects through walls, the principal use of the unit. The testing results showed that the unit performed well, meeting 101 of the 119 requirements. The only SOW requirement which was not met was for unintentional radiation of electromagnetic interference. All tests of detecting moving objects through walls were passed.
DTIC
Surveillance; Walls

20040110483 California Univ., Irvine, CA
Combining Physical and Statistical Models for Recognition in Hyperspectral Images
Healy, Glenn; Dec. 31, 2003; 5 pp.; In English
Contract(s)/Grant(s): F49620-01-1-0182
Report No.(s): AD-A425289; AFRL-SR-AR-TR-04-0414; No Copyright; Avail: CASI; A01, Hardcopy

We have completed work in the areas of physics- based illumination modeling, invariant 3D object recognition, and spectral/spatial modeling. The illumination models consider over 7,000 measured visible through short-wave infrared spectra I irradiance functions. We developed compact representations for the spectra, and used the representations to establish new results for invariant material discriminability. We have also developed models and algorithms for the recognition of 3D objects in unknown illumination conditions. The DIRSIG image generation code was used to build invariant spectral/spatial 3D object models. The algorithms have been applied to a series of hyperspectral images with varying spatial resolution. We have also developed a multi- scale opponent representation to hyperspectral texture based on Gabor filter outputs. We have applied this

representation to hyperspectral texture classification in AVIRIS images. We have also developed a more detailed hyperspectral spatial structure model using multiband correlation functions.
DTIC
Imagery; Mathematical Models

20040110657 NASA Langley Research Center, Hampton, VA, USA
A Comparison of the Multiscale Retinex With Other Image Enhancement Techniques
Rahman, Zia-Ur; Woodell, Glenn A.; Jobson, Daniel J.; [1997]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The multiscale retinex with color restoration (MSRCR) has shown itself to be a very versatile automatic image enhancement algorithm that simultaneously provides dynamic range compression, color constancy, and color rendition. A number of algorithms exist that provide one or more of these features, but not all. In this paper we compare the performance of the MSRCR with techniques that are widely used for image enhancement. Specifically, we compare the MSRCR with color adjustment methods such as gamma correction and gain/offset application, histogram modification techniques such as histogram equalization and manual histogram adjustment, and other more powerful techniques such as homomorphic filtering and 'burning and dodging'. The comparison is carried out by testing the suite of image enhancement methods on a set of diverse images. We find that though some of these techniques work well for some of these images, only the MSRCR performs universally well on the test set.
Author
Algorithms; Image Enhancement; Color; Homomorphisms

20040110683 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Autonomous Multi-Sensor Coordination: The Science Goal Monitor
Koratkar, Anuradha; Grosvenor, Sandy; Jung, John; Hess, Melissa; Jones, Jeremy; [2004]; 1 pp.; In English; SPIE International Asia-Pacific Symposium on Remote Sensing of the Atmosphere, Environment and Space, 8-12 Nov. 2004, Honolulu, HI, USA; Copyright; Avail: Other Sources; Abstract Only

Many dramatic earth phenomena are dynamic and coupled. In order to fully understand them, we need to obtain timely coordinated multi-sensor observations from widely dispersed instruments. Such a dynamic observing system must include the ability to Schedule flexibly and react autonomously to sciencehser driven events; Understand higher-level goals of a sciencehser defined campaign; Coordinate various space-based and ground-based resources/sensors effectively and efficiently to achieve goals. In order to capture transient events, such a 'sensor web' system must have an automated reactive capability built into its scientific operations. To do this, we must overcome a number of challenges inherent in infusing autonomy. The Science Goal Monitor (SGM) is a prototype software tool being developed to explore the nature of automation necessary to enable dynamic observing. The tools being developed in SGM improve our ability to autonomously monitor multiple independent sensors and coordinate reactions to better observe dynamic phenomena. The SGM system enables users to specify what to look for and how to react in descriptive rather than technical terms. The system monitors streams of data to identify occurrences of the key events previously specified by the scientisther. When an event occurs, the system autonomously coordinates the execution of the users' desired reactions between different sensors. The information can be used to rapidly respond to a variety of fast temporal events. Investigators will no longer have to rely on after-the-fact data analysis to determine what happened. Our paper describes a series of prototype demonstrations that we have developed using SGM and NASA's Earth Observing-1 (EO-1) satellite and Earth Observing Systems' Aqua/Terra spacecrafts' MODIS instrument. Our demonstrations show the promise of coordinating data from different sources, analyzing the data for a relevant event, autonomously updating and rapidly obtaining a follow-on relevant image. SGM was used to investigate forest fires, floods and volcanic eruptions. We are now identifying new Earth science scenarios that will have more complex SGM reasoning. By developing and testing a prototype in an operational environment, we are also establishing and gathering metrics to gauge the success of automating science campaigns.
Author
Multisensor Fusion; Autonomy; Software Development Tools; Onboard Data Processing

20040110685 NASA Langley Research Center, Hampton, VA, USA
Advanced Image Processing for Defect Visualization in Infrared Thermography
Plotnikov, Yuri A.; Winfree, William P.; [1997]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Results of a defect visualization process based on pulse infrared thermography are presented. Algorithms have been developed to reduce the amount of operator participation required in the process of interpreting thermographic images. The

algorithms determine the defect's depth and size from the temporal and spatial thermal distributions that exist on the surface of the investigated object following thermal excitation. A comparison of the results from thermal contrast, time derivative, and phase analysis methods for defect visualization are presented. These comparisons are based on three dimensional simulations of a test case representing a plate with multiple delaminations. Comparisons are also based on experimental data obtained from a specimen with flat bottom holes and a composite panel with delaminations.
Author
Defects; Image Processing; Infrared Radiation; Thermography; Mathematical Models; Scientific Visualization

20040110748 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
US Team Member Participation in the Ozone Monitoring Experiment on EOS CHEM
Chance, Kelly; August 2004; 2 pp.; In English
Contract(s)/Grant(s): NAS5-00172; No Copyright; Avail: CASI; A01, Hardcopy

Progress on OMI operational algorithms for BrO, OClO, and HCHO includes: A parameterization scheme for OMI instrument function lab measurements was developed for both UV and Visible instrument channels. The scheme was implemented for all three PGEs and extensively tested. PGEs now have the option of either using the parameterized lab measurements or fitting a symmetric or asymmetric Gaussian function on-line.
Author
Earth Observing System (EOS); Ozone; Satellite-Borne Instruments

20040110842 NASA Glenn Research Center, Cleveland, OH, USA
Development of Thin Film Ceramic Thermocouples for High Temperature Environments
Wrbanek, John D.; Fralick, Gustave C.; Farmer, Serene C.; Sayir, Ali; Blaha, Charles A.; Gonzalez, Jose M.; August 2004; 16 pp.; In English; 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): WBS 22-794-20-55
Report No.(s): NASA/TM-2004-213211; AIAA Paper 2004-3549; E-14719; No Copyright; Avail: CASI; A03, Hardcopy

The maximum use temperature of noble metal thin film thermocouples of 1100 C (2000 F) may not be adequate for use on components in the increasingly harsh conditions of advanced aircraft and next generation launch technology. Ceramic-based thermocouples are known for their high stability and robustness at temperatures exceeding 1500 C, but are typically found in the form of rods or probes. NASA Glenn Research Center is investigating the feasibility of ceramics as thin film thermocouples for extremely high temperature applications to take advantage of the stability and robustness of ceramics and the non-intrusiveness of thin films. This paper will discuss the current state of development in this effort.
Author
Ceramics; Thin Films; Thermocouples; High Temperature Environments

20040110900 NASA Langley Research Center, Hampton, VA, USA
Automated Wing Twist And Bending Measurements Under Aerodynamic Load
Burner, A. W.; Martinson, S. D.; [1996]; 10 pp.; In English; 19th AIAA Advanced Measurement and Ground Testing Technology Conference, 17-20 Jun. 1996, New Orleans, LA, USA
Report No.(s): AIAA Paper 96-2253; Copyright; Avail: CASI; A02, Hardcopy

An automated system to measure the change in wing twist and bending under aerodynamic load in a wind tunnel is described. The basic instrumentation consists of a single CCD video camera and a frame grabber interfaced to a computer. The technique is based upon a single view photogrammetric determination of two dimensional coordinates of wing targets with a fixed (and known) third dimensional coordinate, namely the spanwise location. The measurement technique has been used successfully at the National Transonic Facility, the Transonic Dynamics Tunnel, and the Unitary Plan Wind Tunnel at NASA Langley Research Center. The advantages and limitations (including targeting) of the technique are discussed. A major consideration in the development was that use of the technique must not appreciably reduce wind tunnel productivity.
Author
Wing Loading; Aeroelasticity; Test Facilities; CCD Cameras; Photogrammetry

20040110960 NASA Langley Research Center, Hampton, VA, USA
Progress of Multicolor Single Detector to Detector Array Development for Remote Sensing
Abedin, M. Nurul; Refaat, Tamer F.; Bhat, Ishwara; Xiao, Ye-Gao; Bandra, Sumith; Gunapala, Sarath D.; [2004]; 9 pp.; In English; SPIE's 49th Annual Meeting, 2-6 Aug. 2004, Denver, CO, USA
Contract(s)/Grant(s): 23-319-02-01
Report No.(s): SPIE-5543-25; Copyright; Avail: CASI; A02, Hardcopy

Knowledge of the spatial and temporal distribution of atmospheric species such as CO2, O3, H2O, and CH4 is important for understanding the chemistry and physical cycles involving Earth s atmosphere. Although several remote sensing techniques are suitable for such measurements they are considered high cost techniques involving complicated instrumentation. Therefore, simultaneous measurement of atmospheric species using a single remote sensing instrument is significant for minimizing cost, size and complexity. While maintaining the instrument sensitivity and range, quality of multicolor detector, in terms of high quantum efficiency and low noise are vital for these missions. As the first step for developing multicolor focal plan array, the structure of a single element multicolor detector is presented in this paper. The detector consists of three p-n junction layers of Si, GaSb and InAs wafer bonded to cover the spectral range UV to 900 nm, 800 nm to 1.7 m, and 1.5 m to 3.4 m, respectively. Modeling of the absorption coefficient for each material was carried out for optimizing the layers thicknesses for maximum absorption. The resulted quantum efficiency of each layer has been determined except InAs layer. The optical and electrical characterization of each layer structure is reported including dark current and spectral response measurements of Si pin structure and of GaSb and InAs p-n junctions. The effect of the material processing is discussed.
Author
Remote Sensing; Fabrication; Atmospheric Chemistry; Atmospheric Composition

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*.

20040100765 NASA Langley Research Center, Hampton, VA, USA
Nd: LuLF: A New Nd Laser Material
Barnes, Norman P.; Murray, Keith E.; Walsh, Brian M.; Castillo, Vida K.; Quarles, Gregory J.; [1998]; 4 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

Nd:LuLF, a novel laser material isomorphic to YLF, has been grown and evaluated on both polarizations in a simple, wavelength selective resonator.
Author
Laser Materials; Neodymium Lasers; Lutetium; Lithium Fluorides; Polarization

20040100802 NASA Langley Research Center, Hampton, VA, USA
Flashlamp Pumped, Room Temperature, Nd:YAG Laser Operating at 0.946 Micrometers
Barnes, Norman P.; Murray, Keith E.; Walsh, Brian M.; [1998]; 4 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

Room temperature operation of flashlamp pumped Nd:YAG at 0.946 micrometers was achieved with a laser rod having undoped ends. Performance was characterized and compared with 1.064 micrometer operation and other quasi four level lasers.
Author
Flash Lamps; Neodymium Lasers; Room Temperature; Yag Lasers; Laser Pumping

20040110363 NASA Langley Research Center, Hampton, VA, USA
Application of Laser Based Ultrasound for NDE of Damage in Thick Stitched Composites
Anastasi, Robert F.; Friedman, Adam D.; Hinders, Mark K.; Madaras, Eric I.; [1997]; 13 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

As design engineers implement new composite systems such as thick, load bearing composite structures, they must have certifiable confidence in structure s durability and worthiness. This confidence builds from understanding the structural response and failure characteristics of simple components loaded in testing machines to tests on full scale sections. Nondestructive evaluation is an important element which can provide quantitative information on the damage initiation, propagation, and final failure modes for the composite structural components. Although ultrasound is generally accepted as a test method, the use of conventional ultrasound for in-situ monitoring of damage during tests of large structures is not practical. The use of lasers to both generate and detect ultrasound extends the application of ultrasound to in- situ sensing of damage in a deformed structure remotely and in a non-contact manner. The goal of the present research is to utilize this technology to monitor damage progression during testing. The present paper describes the application of laser based

ultrasound to quantify damage in thick stitched composite structural elements to demonstrate the method. This method involves using a Q-switched laser to generate a rapid, local linear thermal strain on the surface of the structure. This local strain causes the generation of ultrasonic waves into the material. A second laser used with a Fabry-Perot interferometer detects the surface deflections. The use of fiber optics provides for eye safety and a convenient method of delivering the laser over long distances to the specimens. The material for these structural elements is composed of several stacks of composite material assembled together by stitching through the laminate thickness that ranging from 0.5 to 0.8 inches. The specimens used for these nondestructive evaluation studies had either impact damage or skin/stiffener interlaminar failure. Although little or no visible surface damage existed, internal damage was detected by laser based ultrasound.
Author
Lasers; Ultrasonic Radiation; Nondestructive Tests; Damage; Structural Failure; Composite Materials

20040110398 NASA Langley Research Center, Hampton, VA, USA
Ho:Tm:Er:LuAG and Two Wavelength Oscillation
Barnes, Norman P.; Murray, Keith E.; Walsh, Brian M.; Hutcheson, Ralph L.; [1997]; 3 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

Ho:Tm:Er:LuAG demonstrated simultaneous laser oscillation associated with two different transitions and different atoms. Two wavelength oscillation, or TWO, can be achieved in a single laser and single resonator. Moreover, the wavelength can be electronically controlled by varying the pump pulse length, Either the short wavelength, the Ho (5)1(sub 7) to (5)1(sub 8) transition at 2.1 microns, or the long wavelength, the Er (4)1(sub 11/2) to (4)1(sub 13/2) transition at 2.7 microns, or both wavelengths simultaneously can be produced without resorting to mechanical intervention. Consequently, a single laser system can easily switch between producing either of these useful wavelengths. Laser operation of both transitions has been characterized and is presented.
Author
Solid State Lasers; Oscillations; Optical Resonators

20040110407 NASA Langley Research Center, Hampton, VA, USA
Room-Temperature, Diode-Pumped Ho:Tm:YLF Laser Amplifiers Generating 700 mJ at 2-microns
Williams-Byrd, Julie A.; Singh, Upendra N.; Barnes, Norman P.; Lockard, George E.; Modlin, Edward A.; Yu, Jurong; [1997]; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Q-switched, 400-ns pulses with output energy of 700 mJ at 2-microns, representing an optical-to-optical efficiency of 2%, was achieved from five diode-pumped Ho:Tm:YLF laser amplifiers at room-temperature.
Author
Diodes; Laser Arrays; Q Switched Lasers; Optical Radar

20040110496 Industrial Coll. of the Armed Forces, Washington, DC
Munitions: An Industry in Peril
Carlton, Sonia; Kwolek, James; Lumpkins, Sue; Maunz, Peter; Carson, Peggy; Jun. 6, 2002; 35 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425329; No Copyright; Avail: CASI; A03, Hardcopy

Munitions are a critical element of USA national security. The U. S. industrial base is able to produce high quality munitions that are the best in the world, but currently suffers from serious problems. Problems result from a steady decline in procurement funding over the past several decades, and systemic shortfalls in research and development funds. Efforts to stimulate efficiency have instead driven a long series of industry consolidations resulting in loss of competition and increasing corporate debt. Second and third tier suppliers have been eliminated, replaced by small niche companies with limited capabilities. The highly skilled munitions workforce and most government facilities are aging and not being effectively replaced. Program Manager efforts to promote efficiency by purchasing explosives, fuzes or components off-shore resulted in further damage to the domestic industry. Concerns exist that the lack of surge capacity may hazard U.S. security strategy for large- scale contingencies. Inadequate oversight by DoD and confused policies and generation of requirements by the services needs attention. Future systems will incorporate even greater precision and lethality, limiting U.S. casualties and collateral damage. Autonomous weapons, requiring minimal human intervention and the potential for directed energy weapons might someday make the munitions of today obsolete. The U.S. must decide if we will support our struggling industrial base or if we should look to overseas sources of munitions, accepting risks inherent in globalization. Whatever the future holds,

munitions will remain a key element of U.S. military power for decades to come.
DTIC
Ammunition; Industries; Security

20040110890 NASA Langley Research Center, Hampton, VA, USA
A 3-level Model for Schumann-Runge O2 Laser-Induced Fluorescence
Diskin, Glenn S.; Lempert, Walter R.; Miles, Richard B.; [1996]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

A three level model has been developed for the analysis of Schumann-Runge band (B(sup 3)Sigma(sup -)(sub u) \h-X(sup 3)Sigma(sup -)(sub g)) laser-induced fluorescence of molecular oxygen, O2. Such a model is required due to the severe lower state depletion which can occur when transitions having relatively large absorption cross-sections are excited. Such transitions are often utilized via ArF* or KrF* excimer or dye-laser excitation in high temperature environments. The rapid predissociation of the upper state prevents substantial repopulation of the lower state by collisional processes, and the lower state may be largely depleted, even at laser fluences as low as 10-100 mJ/sq cm. The resulting LIF signal in such cases no longer varies linearly with laser pulse energy, and the extent of the sublinear behavior varies with the particular rovibrational transition of interest. Relating the measured signal to the lower state population, then, necessitates the use of exceedingly low laser fluences. These low fluences in turn lead to the need to compromise spatial resolution in order to generate sufficient signal.
Author
Laser Induced Fluorescence; Schumann-Runge Bands; Oxygen; Diatomic Molecules; Excimer Lasers

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MECHANICAL ENGINEERING

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

20040095957 NASA Langley Research Center, Hampton, VA, USA
Debond Analyses for Stitched Composite Structures
Glaessgen, E. H.; Raju, I. S.; Poe, C. C., Jr.; [1998]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The effect of stitching on mode I and mode II strain energy release rates for debond configurations is studied using an analysis based on plate finite elements and the virtual crack closure technique. The stitches were modeled as discrete nonlinear fastener elements with a compliance determined by experiment. The axial and shear behavior of the stitches was considered with both the compliances and failure loads assumed to be independent. The mode I strain energy release rate, G(sub I), was shown to decrease once the debond had grown beyond the first row of stitches and was reduced to zero for long debonds, however, the mode II strain energy release rate, G(sub II), continued to be of significant magnitude over the range of debond lengths considered.
Author
Composite Structures; Crack Closure; Debonding (Materials)

20040105560 NASA Langley Research Center, Hampton, VA, USA
Determining Functional Reliability of Pyrotechnic Mechanical Devices
Bement, Laurence J.; Multhaup, Herbert A.; [1997]; 11 pp.; In English
Report No.(s): AIAA Paper 97-2698; Copyright; Avail: CASI; A03, Hardcopy

This paper describes a new approach for evaluating mechanical performance and predicting the mechanical functional reliability of pyrotechnic devices. Not included are other possible failure modes, such as the initiation of the pyrotechnic energy source. The requirement of hundreds or thousands of consecutive, successful tests on identical components for reliability predictions, using the generally accepted go/no-go statistical approach routinely ignores physics of failure. The approach described in this paper begins with measuring, understanding and controlling mechanical performance variables. Then, the energy required to accomplish the function is compared to that delivered by the pyrotechnic energy source to determine mechanical functional margin. Finally, the data collected in establishing functional margin is analyzed to predict mechanical functional reliability, using small-sample statistics. A careful application of this approach can provide considerable cost improvements and understanding over that of go/no-go statistics. Performance and the effects of variables can be defined,

and reliability predictions can be made by evaluating 20 or fewer units. The application of this approach to a pin puller used on a successful NASA mission is provided as an example.
Author
Reliability Analysis; Failure Modes; Performance Prediction; Pyrotechnics

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QUALITY ASSURANCE AND RELIABILITY

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

20040105569 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Application of Thermo-Mechanical Measurements of Plastic Packages for Reliability Evaluation of PEMS
Sharma, Ashok K.; Teverovsky, Alexander; [2004]; 8 pp.; In English; International Microelectronics and Packaging Conference 2004, 16-18 Jun. 2004, Prague, Czech Republic; No Copyright; Avail: CASI; A02, Hardcopy

Thermo-mechanical analysis (TMA) is typically employed for measurements of the glass transition temperature (Tg) and coefficients of thermal expansion (CTE) in molding compounds used in plastic encapsulated microcircuits (PEMs). Application of TMA measurements directly to PEMs allows anomalies to be revealed in deformation of packages with temperature, and thus indicates possible reliability concerns related to thermo-mechanical integrity and stability of the devices. In this work, temperature dependencies of package deformation were measured in several types of PEMs that failed environmental stress testing including temperature cycling, highly accelerated stress testing (HAST) in humid environments, and bum-in (BI) testing. Comparison of thermo-mechanical characteristics of packages and molding compounds in the failed parts allowed for explanation of the observed failures. The results indicate that TMA of plastic packages might be used for quality evaluation of PEMs intended for high-reliability applications.
Author
Accelerated Life Tests; Thermal Expansion; Reliability Analysis; Encapsulated Microcircuits; Plastic Properties; Deformation; Glass Transition Temperature

20040110812 NASA Langley Research Center, Hampton, VA, USA
Thermal Characterization of Defects in Aircraft Structures Via Spatially Controlled Heat Application
Cramer, K. Elliott; Winfree, William P.; [1997]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Recent advances in thermal imaging technology have spawned a number of new thermal NDE techniques that provide quantitative information about flaws in aircraft structures. Thermography has a number of advantages as an inspection technique. It is a totally noncontacting, nondestructive, imaging technology capable of inspecting a large area in a matter of a few seconds. The development of fast, inexpensive image processors have aided in the attractiveness of thermography as an NDE technique. These image processors have increased the signal to noise ratio of thermography and facilitated significant advances in post-processing. The resulting digital images enable archival records for comparison with later inspections thus providing a means of monitoring the evolution of damage in a particular structure. The National Aeronautics and Space Administration's Langley Research Center has developed a thermal NDE technique designed to image a number of potential flaws in aircraft structures. The technique involves injecting a small, spatially controlled heat flux into the outer surface of an aircraft. Images of fatigue cracking, bond integrity and material loss due to corrosion are generated from measurements of the induced surface temperature variations. This paper will present a discussion of the development of the thermal imaging system as well as the techniques used to analyze the resulting thermal images. Spatial tailoring of the heat coupled with the analysis techniques represent a significant improvement in the delectability of flaws over conventional thermal imaging. Results of laboratory experiments on fabricated crack, disbond and material loss samples will be presented to demonstrate the capabilities of the technique. An integral part of the development of this technology is the use of analytic and computational modeling. The experimental results will be compared with these models to demonstrate the utility of such an approach.
Author
Nondestructive Tests; Thermography; Infrared Imagery; Heating

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STRUCTURAL MECHANICS

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

20040100695 NASA Langley Research Center, Hampton, VA, USA
Model Analysis of an Aircraft Fueslage Panel using Experimental and Finite-Element Techniques
Fleming, Gary A.; Buehrle, Ralph D.; Storaasli, Olaf L.; [1998]; 12 pp.; In English
Contract(s)/Grant(s): NAG1-1684; Copyright; Avail: CASI; A03, Hardcopy

The application of Electro-Optic Holography (EOH) for measuring the center bay vibration modes of an aircraft fuselage panel under forced excitation is presented. The requirement of free-free panel boundary conditions made the acquisition of quantitative EOH data challenging since large scale rigid body motions corrupted measurements of the high frequency vibrations of interest. Image processing routines designed to minimize effects of large scale motions were applied to successfully resurrect quantitative EOH vibrational amplitude measurements
Author
Structural Analysis; Fuselages; Panels

20040100706 NASA Langley Research Center, Hampton, VA, USA
Aircraft Structural Mass Property Prediction Using Conceptual-Level Structural Analysis
Sexstone, Matthew G.; [1998]; 15 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This paper describes a methodology that extends the use of the Equivalent LAminated Plate Solution (ELAPS) structural analysis code from conceptual-level aircraft structural analysis to conceptual-level aircraft mass property analysis. Mass property analysis in aircraft structures has historically depended upon parametric weight equations at the conceptual design level and Finite Element Analysis (FEA) at the detailed design level. ELAPS allows for the modeling of detailed geometry, metallic and composite materials, and non-structural mass coupled with analytical structural sizing to produce high-fidelity mass property analyses representing fully configured vehicles early in the design process. This capability is especially valuable for unusual configuration and advanced concept development where existing parametric weight equations are inapplicable and FEA is too time consuming for conceptual design. This paper contrasts the use of ELAPS relative to empirical weight equations and FEA. ELAPS modeling techniques are described and the ELAPS-based mass property analysis process is detailed. Examples of mass property stochastic calculations produced during a recent systems study are provided. This study involved the analysis of three remotely piloted aircraft required to carry scientific payloads to very high altitudes at subsonic speeds. Due to the extreme nature of this high-altitude flight regime, few existing vehicle designs are available for use in performance and weight prediction. ELAPS was employed within a concurrent engineering analysis process that simultaneously produces aerodynamic, structural, and static aeroelastic results for input to aircraft performance analyses. The ELAPS models produced for each concept were also used to provide stochastic analyses of wing structural mass properties. The results of this effort indicate that ELAPS is an efficient means to conduct multidisciplinary trade studies at the conceptual design level.
Author
Aircraft Structures; Plates (Structural Members); Structural Analysis; Methodology; Structural Weight; Mathematical Models; Concurrent Engineering

20040100709 NASA Langley Research Center, Hampton, VA, USA
Modeling of the Multiparameter Inverse Task of Transient Thermography
Plotnikov, Y. A.; [1998]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Transient thermography employs preheated surface temperature variations caused by delaminations, cracks, voids, corroded regions, etc. Often, it is enough to detect these changes to declare a defect in a workpiece. It is also desirable to obtain additional information about the defect from the thermal response. The planar size, depth, and thermal resistance of the detected defects are the parameters of interest. In this paper a digital image processing technique is applied to simulated thermal responses in order to obtain the geometry of the inclusion-type defects in a flat panel. A three-dimensional finite difference model in Cartesian coordinates is used for the numerical simulations. Typical physical properties of polymer

graphite composites are assumed. Using different informative parameters of the thermal response for depth estimation is discussed.
Derived from text
Mathematical Models; Thermography; Transient Response; Algorithms; Image Processing; Planar Structures

20040105587 NASA Langley Research Center, Hampton, VA, USA
STS-74/MIR Photogrammetric Appendage Structural Dynamics Experiment Preliminary Data Analysis
Gilbert, Michael G.; Welch, Sharon S.; Pappa, Richard S.; Demeo, Martha E.; [1997]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The Photogrammetric Appendage Structural Dynamics Experiment was designed, developed, and flown to demonstrate and prove measurement of the structural vibration response of a Russian Space Station Mir solar array using photogrammetric methods. The experiment flew on the STS-74 Space Shuttle mission to Mir in November 1995 and obtained video imagery of solar array structural response to various excitation events. The video imagery has been digitized and triangulated to obtain response time history data at discrete points on the solar array. This data has been further processed using the Eigensystem Realization Algorithm modal identification technique to determine the natural vibration frequencies, damping, and mode shapes of the solar array. The results demonstrate that photogrammetric measurement of articulating, nonoptically targeted, flexible solar arrays and appendages is a viable, low-cost measurement option for the International Space Station.
Author
Mir Space Station; Photogrammetry; Space Transportation System; Dynamic Structural Analysis; Data Processing

20040105599 NASA Langley Research Center, Hampton, VA, USA
Experimental Characterization of Hysteresis in a Revolute Joint for Precision Deployable Structures
Lake, Mark S.; Fung, Jimmy; Gloss, Kevin; Liechty, Derek S.; [1997]; 13 pp.; In English; 38th Structures, Structural Dynamics and Materials Conference, 7-10 Apr. 1997, Kissimmee, FL, USA
Report No.(s): AIAA Paper 97-1379; Copyright; Avail: CASI; A03, Hardcopy

Recent studies of the micro-dynamic behavior of a deployable telescope metering truss have identified instabilities in the equilibrium shape of the truss in response to low-energy dynamic loading. Analyses indicate that these micro-dynamic instabilities arise from stick-slip friction within the truss joints (e.g., hinges and latches). The present study characterizes the low-magnitude quasi-static load cycle response of the precision revolute joints incorporated in the deployable telescope metering truss, and specifically, the hysteretic response of these joints caused by stick-slip friction within the joint. Detailed descriptions are presented of the test setup and data reduction algorithms, including discussions of data-error sources and data-filtering techniques. Test results are presented from thirteen specimens, and the effects of joint preload and manufacturing tolerances are investigated. Using a simplified model of stick-slip friction, a relationship is made between joint load-cycle behavior and micro-dynamic dimensional instabilities in the deployable telescope metering truss.
Author
Dynamic Loads; Hysteresis; Manufacturing; Joints (Junctions); Spaceborne Telescopes

20040110262 NASA Langley Research Center, Hampton, VA, USA
Activities in Aeroelasticity at NASA Langley Research Center
Perry, Boyd, III; Noll, Thomas E.; [1997]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents the results of recently-completed research and presents status reports of current research being performed within the Aeroelasticity Branch of the NASA Langley Research Center. Within the paper this research is classified as experimental, analytical, and theoretical aeroelastic research. The paper also describes the Langley Transonic Dynamics Tunnel, its features, capabilities, a new open-architecture data acquisition system, ongoing facility modifications, and the subsequent calibration of the facility.
Author
Aeroelasticity; NASA Programs; Research and Development; Transonic Wind Tunnels; Wind Tunnel Tests

20040110276 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Integrated Modeling for the James Webb Space Telescope (JWST) Project: Structural Analysis Activities
Johnston, John; Mosier, Mark; Howard, Joe; Hyde, Tupper; Parrish, Keith; Ha, Kong; Liu, Frank; McGinnis, Mark; [2004]; 10 pp.; In English; NASA/GSFC FEMCI Workshop, 6 May 2004, Greenbelt, MD, USA; Copyright; Avail: CASI; A02, Hardcopy

This paper presents viewgraphs about structural analysis activities and integrated modeling for the James Webb Space Telescope (JWST). The topics include: 1) JWST Overview; 2) Observatory Structural Models; 3) Integrated Performance Analysis; and 4) Future Work and Challenges.
CASI
James Webb Space Telescope; Structural Analysis; Mathematical Models; Space Missions; Systems Integration

20040110321 NASA Langley Research Center, Hampton, VA, USA
Automation of the Image Analysis for Thermographic Inspection
Plotnikov, Yuri A.; Winfree, William P.; [1998]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Several data processing procedures for the pulse thermal inspection require preliminary determination of an unflawed region. Typically, an initial analysis of the thermal images is performed by an operator to determine the locations of unflawed and the defective areas. In the present work an algorithm is developed for automatically determining a reference point corresponding to an unflawed region. Results are obtained for defects which are arbitrarily located in the inspection region. A comparison is presented of the distributions of derived values with right and wrong localization of the reference point. Different algorithms of automatic determination of the reference point are compared.
Author
Thermography; Infrared Imagery; Image Analysis; Data Processing; Tomography

20040110360 NASA Langley Research Center, Hampton, VA, USA
Effect of Pressure in Thermoplastic Ribbon Thermal Welding
Hinkley, J. A.; Messier, B. C.; Marchello, J. M.; [1996]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

An inexpensive apparatus was designed to simulate some features of on-the-fly thermal welding in heated-head tow placement. Previous studies have shown how ply/ply weld strength depends on weld time/temperature history. The apparatus has been modified recently to apply higher contact forces. Welding at pressures up to 1.7MPa (250psi) produced more consistent welds and fewer intra-ply voids, This has permitted a study of the conditions required for achieving the limiting ply/ply cohesive strength in simulated tow placement of a polyimide oligomer.
Author
Welding; Ribbons; Pressure Effects; Thermoplasticity

20040110396 NASA Langley Research Center, Hampton, VA, USA
Viscous Effects in the Elastodynamics of Thick Beams
Johnson, A. R.; Tessler, A.; [1997]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

A viscoelastic higher-order thick beam finite element formulation is extended to include elastodynamic deformations. The material constitutive law is a special differential form of the Maxwell solid. In the constitutive model, the elastic strains and the conjugate viscous strains are coupled through a system of first- order ordinary differential equations. The total time-dependent stress is the superposition of its elastic and viscous components. The elastodynamic equations of motion are derived from the virtual work principle. Computational examples are carried out for a thick orthotropic cantilevered beam. A quasi-static relaxation problem is employed as a validation test for the elastodynamic algorithm. The elastodynamic code is demonstrated by analyzing the damped vibrations of the beam which is deformed and then released to freely vibrate.
Author
Cantilever Beams; Elastodynamics; Viscoelasticity; Viscous Flow; Mathematical Models

20040110663 Lawrence Livermore National Lab., Livermore, CA
Torsional Buckling and Writhing Dynamics of Elastic Cables and DNA
Goyal, S.; Perkins, N. C.; Lee, C. L.; Feb. 14, 2003; 16 pp.; In English
Report No.(s): DE2004-15007472; UCRL-JC-151764; No Copyright; Avail: Department of Energy Information Bridge

Marine cables under low tension and torsion on the sea floor can undergo a dynamic buckling process during which torsional strain energy is converted to bending strain energy. The resulting three-dimensional cable geometries can be highly contorted and include loops and tangles. Similar geometries are known to exist for supercoiled DNA and these also arise from the conversion of torsional strain energy to bending strain energy or, kinematically, a conversion of twist to writhe. A dynamic form of Kirchhoff rod theory is presented herein that captures these nonlinear dynamic processes. The resulting theory is discretized using the generalized- method for finite differencing in both space and time. The important kinematics of cross-section rotation are described using an incremental rotation 'vector' as opposed to traditional Euler angles or Euler

parameters. Numerical solutions are presented for an example system of a cable subjected to increasing twist at one end. The solutions show the dynamic evolution of the cable from an initially straight element, through a buckled element in the approximate form of a helix, and through the dynamic collapse of this helix through a looped form.
NTIS
Angles (Geometry); Buckling; Euler Equations of Motion; Ocean Bottom; Rods; Rotation; Torsion

20040110714 NASA Langley Research Center, Hampton, VA, USA
Effects of Combined Loads on the Nonlinear Response and Residual Strength of Damaged Stiffened Shells
Starnes, James H., Jr.; Rose, Cheryl A.; Rankin, Charles C.; [1996]; 12 pp.; In English; FAA-NASA Symposium on Continued Airworthiness of Aircraft Structures, 28-30 Aug. 1996, Atlanta, GA, USA; No Copyright; Avail: CASI; A03, Hardcopy

The results of an analytical study of the nonlinear response of stiffened fuselage shells with long cracks are presented. The shells are modeled with a hierarchical modeling strategy and analyzed with a nonlinear shell analysis code that maintains the shell in a nonlinear equilibrium state while the crack is grown. The analysis accurately accounts for global and local structural response phenomena. Results are presented for various combinations of internal pressure and mechanical loads, and the effects of crack orientation on the shell response are described. The effects of combined loading conditions and the effects of varying structural parameters on the stress-intensity factors associated with a crack are presented.
Author
Nonlinearity; Residual Strength; Damage; Shells (Structural Forms); Fuselages; Rigid Structures; Cracking (Fracturing)

20040110726 NASA Langley Research Center, Hampton, VA, USA
Instrument Attitude Precision Control
Juang, Jer-Nan; August 1, 2004; 35 pp.; In English
Contract(s)/Grant(s): 23-873-00-2B
Report No.(s): NASA/TM-2004-213251; L-19042; No Copyright; Avail: CASI; A03, Hardcopy

A novel approach is presented in this paper to analyze attitude precision and control for an instrument gimbaled to a spacecraft subject to an internal disturbance caused by a moving component inside the instrument. Nonlinear differential equations of motion for some sample cases are derived and solved analytically to gain insight into the influence of the disturbance on the attitude pointing error. A simple control law is developed to eliminate the instrument pointing error caused by the internal disturbance. Several cases are presented to demonstrate and verify the concept presented in this paper.
Author
Attitude Control; Precision; Feedback Control; Spacecraft Instruments; Numerical Analysis

20040110815 NASA Langley Research Center, Hampton, VA, USA
Sound Transmission through a Cylindrical Sandwich Shell with Honeycomb Core
Tang, Yvette Y.; Robinson, Jay H.; Silcox, Richard J.; [1996]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Sound transmission through an infinite cylindrical sandwich shell is studied in the context of the transmission of airborne sound into aircraft interiors. The cylindrical shell is immersed in fluid media and excited by an oblique incident plane sound wave. The internal and external fluids are different and there is uniform airflow in the external fluid medium. An explicit expression of transmission loss is derived in terms of modal impedance of the fluids and the shell. The results show the effects of (a) the incident angles of the plane wave; (b) the flight conditions of Mach number and altitude of the aircraft; (c) the ratios between the core thickness and the total thickness of the shell; and (d) the structural loss factors on the transmission loss. Comparisons of the transmission loss are made among different shell constructions and different shell theories.
Author
Cylindrical Shells; Honeycomb Cores; Sound Transmission; Sandwich Structures; Mathematical Models; Aircraft Compartments

20040110830 NASA Glenn Research Center, Cleveland, OH, USA
Reduced-Order Modeling and Wavelet Analysis of Turbofan Engine Structural Response Due to Foreign Object Damage (FOD) Events
Turso, James; Lawrence, Charles; Litt, Jonathan; August 2004; 45 pp.; In English
Contract(s)/Grant(s): WBS 22-303-30-72; DA Proj. 1L1-61102-AF-20
Report No.(s): NASA/TM-2004-213118; ARL-TR-3256; E-14612; No Copyright; Avail: CASI; A03, Hardcopy

The development of a wavelet-based feature extraction technique specifically targeting FOD-event induced vibration

signal changes in gas turbine engines is described. The technique performs wavelet analysis of accelerometer signals from specified locations on the engine and is shown to be robust in the presence of significant process and sensor noise. It is envisioned that the technique will be combined with Kalman filter thermal/health parameter estimation for FOD-event detection via information fusion from these (and perhaps other) sources. Due to the lack of high-frequency FOD-event test data in the open literature, a reduced-order turbofan structural model (ROM) was synthesized from a finite element model modal analysis to support the investigation. In addition to providing test data for algorithm development, the ROM is used to determine the optimal sensor location for FOD-event detection. In the presence of significant noise, precise location of the FOD event in time was obtained using the developed wavelet-based feature.
Author
Wavelet Analysis; Structural Analysis; Foreign Bodies; Impact Damage; Turbofan Engines; Gas Turbine Engines

20040110934 NASA Langley Research Center, Hampton, VA, USA
Evaluation of Thin Kevlar-Epoxy Fabric Panels Subjected to Shear Loading
Baker, Donald J.; [1996]; 14 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The results of an analytical and experimental investigation of 4-ply Kevlar-49-epoxy panels loaded by in-plane shear are presented. Approximately one-half of the panels are thin-core sandwich panels and the other panels are solid-laminate panels. Selected panels were impacted with an aluminum sphere at a velocity of either 150 or 220 ft/sec. The strength of panels impacted at 150 ft/sec was not reduced when compared to the strength of the undamaged panels, but the strength of panels impacted at 220 ft/sec was reduced by 27 to 40 percent. Results are presented for panels that were cyclically loaded from a load less than the buckling load to a load in the postbuckling load range. The thin-core sandwich panels had a lower fatigue life than the solid panels. The residual strength of the solid and sandwich panels cycled more than one million cycles exceeded the baseline undamaged panel strengths. The effect of hysteresis in the response of the sandwich panels is not significant. Results of a nonlinear finite element analysis conducted for each panel design are presented.
Author
Epoxy Matrix Composites; Fabrics; Kevlar (Trademark); Thin Plates; Shear Strain; Fatigue Tests

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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*.

20040110313 NASA Langley Research Center, Hampton, VA, USA
Pulsing Inertial Oscillation, Supercell Storms, and Surface Mesonetwork Data
Costen, R. C.; Miller, L. J.; [1998]; 45 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The pulsing inertial oscillation (PIO) model is a nonlinear, time-dependent, translating vortex solution of the inviscid, compressible fluid dynamic equations in the middle troposphere. The translation of this vortex during a pulse is strikingly similar to that of a supercell storm -- a rotating thunderstorm that can generate tornadoes and hail. Two studies were performed to test the hypothesis that some supercell storms are manifestations of a PIO pulse. The first study applied the model to an intense interior draft whose buoyancy was bounded by a temperature excess of +/- 12 K. The peak updraft speed achieved was 41.5 m/ s and the peak Rossby number was 92.9. The study also pointed to an advanced concept for attaining higher values. The second study applied the PIO model to a supercell storm as a whole and succeeded in replicating its bulk properties, such as mesocyclonic circulation, net mass and moisture influxes, and time track. This study also identified a critical feature of the PIO model that could be tested against storm data: The average vertical draft is downward before the turn in the storm track and upward afterwards. In the conventional theory, the average vertical draft is upward from storm inception until dissipation. These differing draft predictions were compared with the best available data, which are surface mesonetwork data. These data were found to support the PIO model. However, surface data alone are not conclusive, and further measurements are warranted.
Author
Oscillations; Inertia; Vertical Air Currents; Time Dependence; Nonlinearity

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*.

20040100730 NASA Langley Research Center, Hampton, VA, USA
Computation of the Effects of Inhomogeneous Clouds on Retrieval of Remotely Sensed Properties
Chambers, Lin H.; [1998]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Current and future earth observation programs depend on satellite measurements of radiance to retrieve the properties of clouds on a global basis. At present, this retrieval is made assuming that the clouds in the instrument field of view are plane parallel and independent of adjacent pixels. While this assumption is known to be false except in very limited cases, its impact can be evaluated, and if possible corrected, based on emerging theoretical techniques. In this study, the Spherical Harmonic Discrete Ordinate Method (SHDOM, Evans, 1996) has been used to assess the sensitivity of the retrieval to a variety of cloud parameters. SHDOM allows the plane parallel assumption to be relaxed and makes 2D and even 3D radiative solutions practical. A previous study (Chambers et al., 1996) assessed the effect of horizontal inhomogeneity in 45 LANDSAT scenes of boundary layer clouds over ocean. The four scenes studied here represent overcast, broken, scattered and strongly thermally forced cloud fields and are used to perform sensitivity studies to a wider variety of parameters. Comparisons are made at three solar zenith angles (theta (sub 0) = 0, 49, and 63 degrees) to avoid ambiguity in the results due to solar zenith angle.
Derived from text
Inhomogeneity; Remote Sensing; Satellite Instruments; Cloud Cover; Cloud Physics

20040105527 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Estimating Terrestrial Carbon Exchange from Space: How Often and How Well?
Knox, Robert G.; Hall, Forrest G.; Huemmrich, Karl F.; Gervin, Janette C.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Data from a new space mission measuring integrated light-use efficiency could provide a breakthrough in understanding of global carbon, water, and energy dynamics, and greatly improve the accuracy of model predictions for terrestrial carbon cycles and climate. Over the past decade, Gamon and others have shown that changes in photo-protective pigments are sensitive indicators of declines in light-use efficiency of plants and plant canopies. The requirements for integrated diurnal measurements from space need to be defined, before a space mission can be formulated successfully using this concept. We used towerbased CO\hsub\g2\h/sub\g flux data as idealized proxies for remote measurements, examining their sampling properties. Thousands of half-hourly CO\hsub\g2\h/dsub\g flux measurements are needed before their average begins to converge on an average annual net CO\hsub\g2\h/sub\g exchange. Estimates of daily integrated fluxes (i.e., diurnal curves) are more statistically efficient, especially if the spacing between measured days is quasiregular, rather than random. Using a few measurements per day one can distinguish among days with different net CO\hsub\g2\h/sub\g exchanges. Fluxes sampled between mid-morning to mid-afternoon are more diagnostic than early morning or late afternoon measurements. Similar results (correlation \g0.935) were obtained using 2 measurements per day with high accuracy ([:plusmn:]5%), 3 measurements per day with medium accuracy ([:plusmn:] 10%), or 5 measurements per day at lower accuracy ([:plusmn:]20%). An observatory in a geosynchronous or near-geosynchronous orbit could provide appropriate observations, as could a multi-satellite constellation in polar orbits, but there is a potential trade-off between the required number of observations per day and quality of each observation.
Author
Carbon Cycle; Diurnal Variations; Remote Sensing; Space Missions; Water; Climate; Gas Exchange

20040105529 NASA Goddard Space Flight Center, Greenbelt, MD, USA
MODIS Solar Calibration Simulation Assisted Refinement
Waluschka, Eugene; Xiaoxiong, Xiong; Guenther, Bruce; Barnes, William; Moyer, David; Salomonson, Vincent V.; [2004]; 1 pp.; In English; SPIE Conference, 8-12 Nov. 2004, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

A detailed optical radiometric model has been created of the MODIS instruments solar calibration process. This model takes into account the orientation and distance of the spacecraft with respect to the sun, the correlated motions of the scan mirror and the sun, all of the optical elements, the detector locations on the visible and near IR focal planes, the solar diffuser and the attenuation screen with all of its hundreds of pinholes. An efficient computational scheme, takes into account all of these factors and has produced results which reproduce the observed time dependent intensity variations on the two focal

planes with considerable fidelity. This agreement between predictions and observations, has given insight to the causes of some small time dependent variations and how to incorporate them into the overall calibration scheme. The radiometric model is described and modeled and actual measurements are presented and compared.
Author
Calibrating; MODIS (Radiometry); Radiometers; Sun; Mathematical Models; Simulation

20040110783 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
US Team Member Participation in the Ozone Monitoring Experiment on EOS Chem
Change, Kelly; August 2004; 2 pp.; In English
Contract(s)/Grant(s): NAS5-00172; No Copyright; Avail: CASI; A01, Hardcopy

Progress on OMI operational algorithms for BrO, OClO, and HCHO includes: Implemented changes to PGE_Description.txt that were required to promote the PGEs to Integration. Studies were initiated for a parameterization of the laboratory measurements of the OMi instrument function for use in the PGEs. V0.9.27 of the PGEs were delivered to the DAAC.
Author
Earth Observing System (EOS); Satellite-Borne Instruments; Ozone

20040110990 Physics and Electronics Lab. TNO, The Hague, Netherlands
Satellite Mapping Generalization
vandenBroek, A. C.; Dekker, R. J.; Greidanus, H.; December 2003; 106 pp.; In Dutch
Contract(s)/Grant(s): A01/KL/958; TNO Proj. 015.32037
Report No.(s): TD-2003-0077; FEL-02-A292; Copyright; Avail: Other Sources

We have studied image mapping using satellite imagery for various mapping scales and various geographical regions. We discriminate between large-scale maps (1:250,000) corresponding to Vmap level I, medium-scale maps (1:50,000) corresponding to Vmap level II and small-scale maps (1:10,000) corresponding to UrbanVmap. Geographical regions considered comprise arid, arctic, tropical and moderate climates. For large-scale maps the image has to be classified into land use classes using multi-spectral imagery, e.g. from Landsat. For medium-scale maps thematic information like roads, urban areas extracted from the image can be overlaid where the image is shown in the background. The small-scale maps consist of a high-resolution optical image (e.g. Ikonos or Quickbird) with the most important features shown in an overlay complemented by annotation. Automatic land use classification is quite feasible when the image is segmented into objects before classification is performed. Bare soil and urban are often confused. Only when texture is used bare soil can be separated from urban areas, which requires high resolution. Image mapping is most feasible for arid regions and less for arctic and tropical regions. In arctic regions light conditions can cause problems for obtaining image maps from satellite imagery.
Author
Satellite Imagery; Mapping; Image Classification

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*.

20040100717 National Renewable Energy Lab., Golden, CO
Modeling the Feasibility of Using Fuel Cells and Hydrogen Internal Combustion Engines in Remote Renewable Energy Systems
Cotrell, J.; Pratt, W.; Sep. 2003; In English
Report No.(s): DE2003-15004825; NREL/TP-500-34648; No Copyright; Avail: National Technical Information Service (NTIS)

Recent advances in hydrogen fuel cell and internal combustion engine technologies have enabled new energy options for supplying electrical power in remote, off-grid areas. The objective of this investigation is to determine under which conditions wind turbines and PV systems can feasibly power electrolyzers to generate and store hydrogen for remote power generation using fuel cells and internal combustion engines. In this study, the optimization software HOMER is used to analyze a small 356-W radio repeater station and a 148-kW village power system. This study concludes that fuel cell systems appear

competitive today at the radio repeater station and appear competitive in the village system if fuel cell prices are reduced to 40% of their current capital cost.
NTIS
Fuel Cells; Internal Combustion Engines; Renewable Energy; Hydrogen Engines

20040110713 Texas Univ., El Paso, TX, USA
Solar and Waste Heat Desalination by Membrane Distillation
Apr. 2004; In English
Report No.(s): PB2004-107002; DWPR-81; No Copyright; Avail: National Technical Information Service (NTIS)
In this study, the desalination performance and O&M procedures of an air-gap type membrane distillation system was tested using low-grade thermal energy (between 13 and 75 oC) supplied by a salt-gradient solar pond. The research included measuring the flux per unit area of membrane surface and separation of ions over a range of feedwater salinities and temperature as well as an assessment of membrane fouling.
NTIS
Distillation; Membranes

45
ENVIRONMENT POLLUTION

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

20040100686 Department of Transportation, Washington, DC, USA
Road Dust Suppression: Effect on Maintenance Stability, Safety and the Environment
Addo, J. Q.; Sanders, T. G.; Chenard, M.; May 2004; In English
Report No.(s): PB2004-105848; No Copyright; Avail: National Technical Information Service (NTIS)
This report describes research conducted at Colorado State University to evaluate the effect of road dust suppression on unpaved road maintenance schemes. A field-based method was used to measure the effect of road soil physical characteristics on the effectiveness of some of the commonly used dust suppressants. The study also evaluated the stabilization of unpaved road base material because of the use of dust suppression. The effect of dust suppression on safety and driving conditions on unpaved roads was examined. The chloride compounds and ligninsulfonate commonly used as dust suppressants are water soluble and can be leached into the environment. They contain chlorides, heavy metals, and organic compounds that are regulated. Their potential to have adverse environmental impact was examined.
NTIS
Dust; Maintenance; Environmental Surveys; Organic Compounds

20040100689 Statewide Air Pollution Research Center, Riverside, CA
Studies of the Atmospheric Chemistry of Volatile Organic Compounds and of their Atmospheric Reaction Products
Atkinson, R.; Arey, J.; 2004; In English
Report No.(s): PB2004-106445; No Copyright; Avail: National Technical Information Service (NTIS)
Large quantities of volatile organic compounds (VOCs) are emitted into the atmosphere from biogenic and anthropogenic sources. In the atmosphere, these VOCs are transformed by photolysis and/or reaction with OH radicals, NO(sub 3) radicals and O(sub 3). There is therefore a need to understand, in detail, the reactions involved in the atmospheric degradation of emitted organic compounds. This includes not only measurements of the rates of reaction and identification and quantification of products formed from the atmospheric reactions of directly emitted chemicals, but also corresponding studies of the first- and later-generation products. In this experimental program, we are using the analytical methods and facilities available at the Air Pollution Research Center at the University of California, Riverside, to investigate the atmospherically important reactions of selected VOCs emitted from biogenic and anthropogenic sources and of their reaction products. We will use our PE SCIEX direct air sampling, atmospheric pressure ionization tandem mass spectrometer (API-MS/MS) in conjunction with in situ Fourier transform infrared (FT-IR) spectroscopy, gas chromatography (GC-FID, GC-FTIR and GC-MS), and product derivatization with GC analyses to identify and quantify VOC reaction products, and to address critical gaps in our understanding of VOC chemistry. Alkyl-PAH are present in diesel fuel, exhaust from diesel-fueled vehicles and other combustion sources, and they have been observed in ambient air. During the first year of this program, we have begun studies of the atmospheric chemistry of alkyl-PAH, including 1- and 2-methylnaphthalene and the 12 dimethylnaphthalene isomers, and will examine the products of the OH radical-initiated reactions as a function of NO2 concentration to attempt to determine

whether the OH-PAH adducts are reacting with NO(sub 2) or O(sub 2). We will also continue methods development for using our API-MS to quantify multifunctional product species such as hydroxynitrates, hydroxycarbonyls, carbonyl-nitrates, etc., from the atmospheric reactions of anthropogenic and biogenic VOCs. This will include the synthesis of hydroxynitrates and carbonyl-nitrates to be used as quantitative standards.
NTIS
Atmospheric Chemistry; Reaction Kinetics; Organic Compounds

20040100693 Office of Management and Budget, Washington, DC
Federal Climate Change Expenditures. Report to Congress
May 2004; 44 pp.; In English
Report No.(s): PB2004-106969; No Copyright; Avail: CASI; A03, Hardcopy

On February 14, 2002, President Bush announced a new national goal to reduce the greenhouse gas emission intensity of the American economy by 18 percent by the year 2012. Achieving this goal will require enhanced and sustained near- and long-term efforts on multiple fronts that are in concert with measures to maintain a strong national economy. The Administration's portfolio includes actions focused on reducing the fundamental scientific uncertainties associated with climate change; advancing the development and introduction of energy-efficient, renewable, and other low- or non-emitting technologies; and improving standards for measuring and registering emissions reductions. Many elements of the Administration's climate change portfolio are designed to incentivize greenhouse gas emissions reductions throughout the USA economy and provide assistance to developing nations to do the same. Progress in these areas will be achieved through a range of programs and crosscutting initiatives.
NTIS
Climate Change; Congressional Reports; Exhaust Emission

20040100710 Swedish Environmental Protection Agency, Stockholm, Sweden, Finnish Meteorological Inst., Helsinki, Finland, Swedish Univ. of Agricultural Science, Uppsala, Sweden, National Environmental Research Inst., Copenhagen, Denmark
Mapping Base Cation Deposition in the Nordic Countries
Lovblad, G.; Persson, C.; Klein, T.; Ruoho-Airola, T.; Hovmand, M.; 2004; In English
Report No.(s): PB2004-107026; IVL-B-1583; No Copyright; Avail: National Technical Information Service (NTIS)

In the integrated assessment modelling to support the strategies of pollution abatement, a need for base cation data over Europe has been expressed. Data are needed by the scientists working with acidification effects and recovery of ecosystems. A study has been made on a procedure for mapping base cation deposition over the Nordic countries, with an additional aim of recommendations for base cation mapping on a European scale. The mapping over the Nordic countries was made using the data assimilation part of the MATCH model, run with a resolution of 11x11 km. The mapping was based on monitoring data for concentrations of base cations in air and precipitation in the Nordic and surrounding countries. A number of years would have been preferred for the calculations. This was not possible for practical reasons. Monitoring data and meteorological conditions for the year 1998 were selected, as the most recent year at the start of the project. The influence of base cation deposition in the calculation of critical loads and their exceedance as well as for the dynamic modelling of recovery processes was analysed and base cation deposition was found to be of significant importance. Base cation deposition from the atmosphere provides, together with weathering, ions for neutralising acidity and, after sufficient reductions of acidifying deposition, a source for replenishing lost base cation pools. For dynamic modelling, the influence of base cation deposition is less important when using models, which are calibrated with monitoring data. However, in prognoses for the future, it is still very with accurate estimates of the base cation deposition. The procedure for mapping base cation deposition proposed in this project represents an improvement with respect to many previous mapping exercises, because it includes both wet and dry estimates of base cation deposition, and because it handles the decreasing sea salt gradients from the coast towards inland. It is recommended in the report to use the experiences from this Nordic mapping activitiy to initiate a process to compile necessary monitoring and emission data in order to carry out a mapping procedure of base cation deposition at European level.
NTIS
Cations; Deposition

20040100711

Regional Marine and Air Pollution Problems in the Nordic Countries. Status and Suggestions for Further Work with NMR's Sea and Air Group

Grennfelt, P.; Mar. 2004; In English

Report No.(s): PB2004-107027; IVL-B-1584; No Copyright; Avail: National Technical Information Service (NTIS)

The main objective of the Sea and Air Group under the Nordic Council of Ministers is to support the Nordic Countries in their work to control large scale marine and transboundary air pollution influencing Nordic countries and adjacent areas. During its 10 year history, the Sea and Air Group has been successful in forming common views and strategies to combat atmospheric and marine pollution. The work has been undertaken in the perspective of the Nordic environmental strategies. During the last years new elements have been introduced into the strategies, such as sustainable development and actions to combat global change. In the present report the different Nordic environmental strategies are briefly presented and discussed from the perspective of marine and air pollution. Status and trends for the main environmental problems are outlined. The policy processes, in particular those through international regional conventions and the European Union are presented and evaluated in terms of achievements, strengths and weaknesses. The report also presents some possible directions for the Sea and Air Group; in relation to environmental problems and priorities as well as in relation to the policy development in Europe.

NTIS

Air Pollution; Water Pollution; Combat

20040100712 Environmental Protection Agency, Washington, DC

Companion Guidance for the July 1, 2004, Final Transportation Conformity Rule. Conformity Implementation in Multi-Jurisdictional Nonattainment and Maintenance Areas for Existing and New Air Quality Standards

Jul. 2004; 52 pp.; In English

Report No.(s): PB2004-107053; EPA/420-B-04-012; No Copyright; Avail: CASI; A04, Hardcopy

The Environmental Protection Agency (EPA) published a final transportation conformity rule for the new air quality standards on July 1, 2004 (69 FR 40004). The final rule describes in general terms how conformity will apply to new nonattainment and maintenance areas under the 8-hour ozone and PM2.5 standards, and how nonattainment areas for the 8-hour ozone standard will use existing adequate or approved motor vehicle emissions budgets ('budgets') in state implementation plans (SIPs) prepared for the 1-hour ozone standard. The transportation conformity rule (40 CFR part 93) outlines the procedures for determining whether federally funded or approved highway and transit projects are consistent with ('conform' to) state air quality goals. Both EPA and the U.S. Department of Transportation (DOT) agree it is necessary to provide additional guidance for conformity implementation to accompany the final rule. EPA is issuing this guidance to clarify how emissions analyses that support them are completed in existing and new nonattainment and maintenance areas, particularly those where multiple agencies or states are involved.

NTIS

Environment Protection; Maintenance; Transportation

20040100713 Swedish Environmental Protection Agency, Stockholm, Sweden

Emission, Transport, and Deposition of Base Cations

Westling, O.; Lovblad, G.; 2004; In English

Report No.(s): PB2004-107028; IVL-B-1585; No Copyright; Avail: National Technical Information Service (NTIS)

The workshop on base cation deposition took place in Gothenburg on 26-28 November 2003. It was an official workshop of the Co-operative Programme for Monitoring and Evaluation of the Long Range Transboundary Air Pollution, EMEP and Working Group on Effects under the UNECE/CLRTAP. It was organised by the Swedish Environmental Research Institute(IVL) and the Swedish Research Programme on International and National Abatement Strategies for Transboundary Air Pollution (ASTA). The Workshop report summarises the state-of-knowledge of emissions, dispersion and deposition of base cations over Europe. The Workshop evaluated in particular the knowledge with respect to mapping the base cation deposition over Europe as a basis for the application of dynamic models in the coming air pollution abatement strategies in Europe. The knowledge reflects the present situation, historical development and prospects for the coming 10-20 years.

NTIS

Cations; Air Pollution; Pollution Control; Conferences; Deposition

20040100714 Environmental Protection Agency, Research Triangle Park, NC, National Oceanic and Atmospheric Administration, Rockville, MD

Operational Evaluation of the Eta-CMAQ (Community Multi-scale Air Quality) Air Quality Forecast Model

Kang, D.; Eder, B.; Mathur, R.; Yu, S.; Schere, K.; 2004; 10 pp.; In English

Report No.(s): PB2004-107204; EPA/600/A-04/080; No Copyright; Avail: CASI; A02, Hardcopy

The purpose of this research has been to provide an operational evaluation of the Eta-CMAQ air quality forecast system using O (sub 3) observations obtained from EPAs AIRNOW program and a suite of statistical metrics for both discrete and categorical forecasts.

NTIS

Forecasting; Evaluation; Ozone; Pollution

20040100716

Air CHIEF, Version 11.0 (on CD-ROM)

Apr. 2004; In English

Report No.(s): PB2004-500150; EPA/454/C-04/001; No Copyright; Avail: National Technical Information Service (NTIS)

The Clearing House For Inventories And Emission Factors (Air CHIEF) CD-ROM gives the public and private sector users access to air emission data specific to estimating the types and quantities of pollutants that may be emitted from a wide variety of sources. Updated annually, Air CHIEF offers on one disc literally thousands of pages contained in some of EPA's most widely used and requested documents. Included are the US EPA Emission Factor and Inventory Group's most popular emission estimation tools. Included on the CD-ROM are: - Compilation of Air Pollutant Emission Factors (AP-42), Fifth Edition, Volume 1: Stationary Point and Area. This contains information on over 200 stationary source categories. It includes brief descriptions of processes used, potential sources of air emissions from the processes and in many cases common methods used to control these air emissions. Methodologies for estimating the quantity of air pollutant emissions are presented in the form of Emission Factors. - Sources (including Supplements A, B, C and D). These characterize the source categories for which emissions of a toxic substance have been identified. These volumes include general descriptions of the emitting processes, identifying potential release points and emission factors: Compilation of Air Pollutant Emission Factors (AP-42), AP-42 Background Files; Locating and Estimating Document Series; Emission Inventory Improvement Program Documents; Source Classification codes(SCC)/Area and Mobile Source (AMS) Codes. The latest National Emission Inventory documentation for criteria and hazardous air pollutants has been added to the CD. Also included on Air CHIEF are the installable copies of these software programs: Factor Information Retrieval (FIRE), PC BEIS, PMCALC and TANKS.

NTIS

Air Pollution; Exhaust Emission; Computer Programs

20040105524 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Black Carbon in Estuarine and Coastal Ocean Dissolved Organic Matter

Mannino, Antonio; Harvey, H. Rodger; [2003]; 22 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Black carbon (BC) in ultrafiltered high-molecular-weight DOM (UDOM) was measured in surface waters of Delaware Bay, Chesapeake Bay and the adjacent Atlantic Ocean (USA) to ascertain the importance of riverine and estuarine DOM as a source of BC to the ocean. BC comprised 5-72% of UDOM-C (27+/-17%) and on average 8.9+/-6.5% of dissolved organic carbon (DOC) with higher values in the turbid region of the Delaware Estuary and lower yields in the river and coastal ocean. The spatial and seasonal distributions of BC along the salinity gradient of Delaware Bay suggest that the higher levels of BC in surface water UDOM originated from localized sources, possibly from atmospheric deposition or released from resuspended sediments. Black carbon comprised 4 to 7% of the DOC in the coastal Atlantic Ocean, revealing that river-estuary systems are important exporters of colloidal BC to the ocean. The annual flux of BC from Delaware Bay UDOM to the Atlantic Ocean was estimated at 2.4x10(exp 10) g BC yr(exp -1). The global river flux of BC through DOM to the ocean could be on the order of 5.5x1O(exp 12)g BC yr (exp -1). These results support the hypothesis that the DOC pool is the intermediate reservoir in which BC ages prior to sedimentary deposition.

Author

Atlantic Ocean; Chesapeake Bay (US); Delaware Bay (US); Carbon; Rivers; Estuaries; Dissolved Organic Matter

20040110389 NASA Langley Research Center, Hampton, VA, USA

Remote Sensing from Geostationary Orbit: GEO TROPSAT, A New Concept for Atmospheric Remote Sensing

Little, Alan D.; Neil, Doreen O.; Sachse, Glen W.; Fishman, Jack; Krueger, Arlin J.; [1997]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The Geostationary Tropospheric Pollution Satellite (GEO TROPSAT) mission is a new approach to measuring the critical constituents of tropospheric ozone chemistry: ozone, carbon monoxide, nitrogen dioxide, and aerosols. The GEO TROPSAT mission comprises a constellation of three instruments flying as secondary payloads on geostationary communications satellites around the world. This proposed approach can significantly reduce the cost of getting a science payload to geostationary orbit and also generates revenue for the satellite owners. The geostationary vantage point enables simultaneous high temporal and spatial resolution measurement of tropospheric trace gases, leading to greatly improved atmospheric ozone chemistry knowledge. The science data processing, conducted as a research (not operational) activity, will provide atmospheric trace gas data many times per day over the same region at better than 25 km ground footprint. The high temporal resolution identifies short time scale processes, diurnal variations, seasonal trends, and interannual variation.
Author
Remote Sensing; Geosynchronous Orbits; Atmospheric Chemistry; Ozone; Troposphere

20040110413 NASA Langley Research Center, Hampton, VA, USA
Asian Outflow and Trans-Pacific Transport of Carbon Monoxide and Ozone Pollution: An Integrated Satellite, Aircraft, and Model Perspective
Heald, Colette L.; Jacob, Daniel J.; Fiore, Arlene M.; Emmons, Louisa K.; Gille, John C.; Deeter, Merritt N.; Warner, Ju-Ying; Edwards, David P.; Crawford, James H.; Hamlin, Amy J., et al.; Journal of Geophysical Research; 2003; ISSN 0148-0227; Volume 108, No. D24, pp. 25-1 - 25-17; In English
Contract(s)/Grant(s): NAG1-2328; NGT5-30466; Copyright; Avail: Other Sources

Satellite observations of carbon monoxide (CO) from the Measurements of Pollution in the Troposphere (MOPITT) instrument are combined with measurements from the Transport and Chemical Evolution Over the Pacific (TRACE-P) aircraft mission over the northwest Pacific and with a global three-dimensional chemical transport model (GEOS-CHEM) to quantify Asian pollution outflow and its trans-Pacific transport during spring 2001. Global CO column distributions in MOPITT and GEOS-CHEM are highly correlated (R(exp 2) = 0.87), with no significant model bias. The largest regional bias is over Southeast Asia, where the model is 18% too high. A 60% decrease of regional biomass burning emissions in the model (to 39 Tg/yr) would correct the discrepancy; this result is consistent with TRACE-P observations. MOPITT and TRACE-P also give consistent constraints on the Chinese source of CO from fuel combustion (181 Tg CO/yr). Four major events of trans-Pacific transport of Asian pollution in spring 2001 were seen by MOPITT, in situ platforms, and GEOS-CHEM. One of them was sampled by TRACE-P (26-27 February) as a succession of pollution layers over the northeast Pacific. These layers all originated from one single event of Asian outflow that split into northern and southern plumes over the central Pacific. The northern plume (sampled at 6-8 km off California) had no ozone enhancement. The southern subsiding plume (sampled at 2-4 km west of Hawaii) contained a 8 - 17 ppbv ozone enhancement, driven by decomposition of peroxyacetylnitrate (PAN) to nitrogen oxides (NOx). This result suggests that PAN decomposition in trans-Pacific pollution plumes subsiding over the USA could lead to significant enhancements of surface ozone.
Author
Pacific Ocean; Pollution Transport; Carbon Monoxide; Ozone

20040110612 Utah Univ., Salt Lake City, UT, USA, Utah Geological and Mineralogical Survey, Salt Lake City, UT, USA, Department of Scientific and Industrial Research, Lower Hutt, New Zealand
Reactive Multiphase Behavior of CO2 in Saline Auifers Beneath the Colorado Plateau
Allis, R. G.; Moore, J.; White, S.; Jan. 30, 2003; In English
Report No.(s): DE2003-820426; No Copyright; Avail: National Technical Information Service (NTIS)

Gas reservoirs developed within the Colorado Plateau and Southern Rocky Mountains region represent unique natural laboratories for studying the conditions that control long-term storage of CO2. Under appropriate conditions, the trapping of CO2 in mineral phases could equal or exceed the amount of CO2 sequestered in the pore fluids in deep aquifers. Core samples from the Springerville-St. Johns CO2 field has allowed investigation of naturally occurring mineral reactions. The presence of travertine deposits over the field provide evidence of the leakage of CO2 to the atmosphere and justify further study.
NTIS
Carbon Dioxide; Core Sampling; Reservoirs; Reactivity

20040110708 Sciences International, Inc., Alexandria, VA, USA
Exploratory Data Analysis of Benzene and 1,3-Butadiene Measurements for Air Toxics Risk Assessment in Houston
Aug. 09, 2004; 46 pp.; In English
Report No.(s): PB2004-107216; No Copyright; Avail: CASI; A03, Hardcopy

This report presents an analysis of air toxics data in the Houston, Texas, area. Specifically, the report focuses on benzene and 1,3-butadiene, which are key drivers in air toxics risk assessment. The report includes two major parts: (1) an analysis of the sources of variation in the air toxics data, and (2) a comparison of monitoring data with modeling estimates. All data for benzene and 1,3-butadiene in the Houston area were obtained from the Texas Commission on Environmental Quality (TCEQ) for the period of 1996-2003. The data included 15 stations, including one collocated station at Port Arthur. Most of the stations are east of the Houston city center in the Houston Ship Channel area, and there are several stations to the west of Houston. In Section 2, some summary statistics were calculated and the trends in concentration data over time were analyzed. We reached the following conclusions from this analysis: For both benzene and 1, 3-butadiene, the concentrations were highest at the stations east of Houston in the Ship Channel as would be expected given the higher amount of industrial emissions. There is a general declining trend that is evident in the benzene and 1,3-butadiene measurement data over time. Across all of the monitors, the trend for benzene was -1.3% per year, and the trend for 1, 3-butadiene was -1.7% per year. Because of several issues discussed in the report, this analysis cannot be considered definitive.
NTIS
Air Pollution; Toxicology; Benzene

20040110710 Denver Univ., Denver, CO, USA
On-Road Remote Sensing of Automobile Emissions in the Denver Area: Year 4, January 2003
Burgard, D. A.; Bishop, G. A.; Williams, M. J.; Stedman, D. H.; 2004; In English
Report No.(s): PB2004-107215; No Copyright; Avail: National Technical Information Service (NTIS)

The University of Denver has completed the fourth year of a multi-year remote sensing study in the Denver area. The remote sensor used in this study is capable of measuring the ratios of CO, HC and NO to CO2 in motor vehicle exhaust. From these ratios, we calculate the percent concentrations of CO, CO2, HC and NO in the exhaust that would be observed by a tailpipe probe, corrected for water and excess oxygen not involved in combustion. Mass emissions per mass or volume of fuel can also be determined. The system used in this study was configured to determine the speed and acceleration of the vehicle, and was accompanied by a video system to record license plates.
NTIS
Remote Sensing; Air Pollution; Exhaust Emission

20040110711 Environmental Protection Agency, Washington, DC
Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation
Aug. 2004; 86 pp.; In English
Report No.(s): PB2004-107054; EPA/420-R-04-013; No Copyright; Avail: CASI; A05, Hardcopy

MOBILE6 is a software program designed by the U.S. Environmental Protection Agency to estimate emission rates for the highway motor vehicle fleet under a range of conditions. MOBILE6.0 was released in January, 2002. This was the latest in a series of MOBILE models dating back to 1978 and was the first update in MOBILE since the release on MOBILE5b in 1996 and the first major update since the release of MOBILE5 in 1992. MOBILE6.2 is the first and latest update to MOBILE6 and adds the capability to estimate particulate matter (PM) and mobile source air toxics emissions. MOBILE6.2 contains very minor modifications to MOBILE6 for the parts of the model that estimate emissions of hydrocarbons (HC), nitrogen oxides (NOx), and carbon monoxide (CO). The original technical guidance for MOBILE6 was released in 2002. Changes to the model have necessitated an update to the technical guide. Most of this version of the technical guidance is unchanged from the 2002 version.
NTIS
Air Pollution; Motor Vehicles; Exhaust Emission

20040110715 Environmental Protection Agency, Research Triangle Park, NC, Clean Air Vehicle Technology Center, Research Triangle Park, NC, USA
Characterization of Emissions from Malfunctioning Vehicles Fueled with Oxygenated Gasoline-Ethanol (E-10) Fuel. Part 3
Stump, F.; Dropkin, D.; Tejada, S.; Loomis, C.; Park, C.; 2001; 82 pp.; In English
Report No.(s): PB2004-106735; EPA/600/R-01/053-3; No Copyright; Avail: CASI; A05, Hardcopy

Five vehicles, a 1987 Ford Taurus, a 1996 Chrysler Concord, a 2001 Ford Focus (Low Emission Vehicle (LEV)), a 1993 Buick Regal, and a 2001 Dodge Intrepid (LEV) were tested using three different fuels: (1) winter grade (E-10) fuel containing 10% (vol.) 200 proof ethanol, (2) winter grade (WG) fuel without any ethanol or oxygen containing compounds, and (3)

summer grade (SG) fuel without oxygenates. The vehicles were tested in the conditions in which they were obtained from either a private individual or a vehicle rental service. They were also tested in a simulated malfunction mode in which the oxygen sensor was disconnected.
NTIS
Exhaust Emission; Air Pollution; Automobiles; Gasoline; Ethyl Alcohol; Automobile Fuels

20040110729 Environmental Protection Agency, Research Triangle Park, NC
Performance Evaluation of the 2004 Release of Models-3 CMAQ (Community Multi-scale Air Quality)
Yu, S.; Eder, B. K.; 2004; 10 pp.; In English
Report No.(s): PB2004-106736; EPA/600/A-04/081; No Copyright; Avail: CASI; A02, Hardcopy

This performance evaluation of the 2004 release of CMAQ reveals that the model's ability to accurately simulate the various species continues to improve, especially for NO3 concentrations, which have improved markedly since an earlier evaluation (Mebust et al., 2003). Both SO4 and NH4 continue to be well simulated by the model, as does PM(sub 2.5). Although simulations of the carbon species are somewhat deficient, improvements in both OC and EC simulations are expected with future releases of CMAQ as the scientific community's understanding of these species matures. Potential areas of research into the sources of the deficiencies identified in this evaluation include uncertainties in emissions inventories, imperfect representation of the meteorological fields, a as well as an incomplete understanding of aerosol dynamics in the CMAQ aerosol component.
NTIS
Performance Tests; Air Quality; Meteorological Parameters

20040110730 Environmental Protection Agency, Cincinnati, OH
Source Apportionment of Primary Carbonaceous Aerosol Using the Community Multiscale Air Quality Model
Bhave, P. V.; Pouliot, G. A.; Zheng, M.; 2004; 10 pp.; In English
Report No.(s): PB2004-106732; EPA/600/A-04/074; No Copyright; Avail: CASI; A02, Hardcopy

Over the past decade, the U.S. Environmental Protection Agency (EPA) in cooperation with state and local agencies has developed a National Emission Inventory (NEI) for fine particulate matter (PM) (EPA, 2001). In addition, the EPA has been developing the Community Multiscale Air Quality (CMAQ) model for the mechanistic prediction of gas and aerosol-phase pollutant concentrations (Byun and Ching, 1999). In the present work, an extension to the CMAQ model is described that allows the user to track the emissions from an arbitrary number of primary aerosol sources as they are transported through the atmosphere. The model is coupled with the National Emissions Inventory (NEI) NEI to estimate primary carbonaceous aerosol concentration increments contributed by nine major emission categories over the continental U.S. from June 15 August 31, 1999. Model results are evaluated against source-specific molecular measurements collected at eight receptor sites in the southeastern U.S.
NTIS
Air Quality; Particulates; Environment Protection

20040110731 Environmental Protection Agency, Washington, DC, USA
NOx Budget Trading Program, 2003 Progress and Compliance Report
Aug. 2004; In English
Report No.(s): PB2004-106718; EPA/430/R-04/010; No Copyright; Avail: National Technical Information Service (NTIS)

The NOx Budget Trading Program (NBP), is a market-based cap and trade program created to reduce emissions of nitrogen oxides (NOx) from power plants and other large combustion sources in the eastern USA. NOx is a prime ingredient in the formation of ground-level ozone (smog). This report finds that, in states that participated during the first year of the program, ozone season (May through September) NOx emissions from power plants and other large combustion sources were reduced by more than 30 percent from 2002 levels. These emission reductions occurred despite an increase in heat input (a measure of power generation) at affected sources. Emissions have also been reduced by 70 percent from 1990 levels due to the combination of the NBP and other NOx control programs. In 2003, of the total affected population of approximately 1,000 units, all but 7 were in compliance.
NTIS
Nitrogen Oxides; Heat Generation; Combustion

20040110739 Netherlands Energy Research Foundation, Petten
High Efficiency Co-Production of Fischer-Tropsch (FT) Transportation Fuels and Substitute Natural Gas (SNG) from Biomass
Boerrigter, H.; Zwart, R. W.; Feb. 2004; In English
Report No.(s): PB2004-105317; ECN-C-04-001; Copyright; Avail: National Technical Information Service (NTIS)

Production of 'green' substitute natural gas (SNG) and transportation fuels will allow the use of the existing natural gas and transportation fuels infrastructure and, hence, make a gradual transition from the present fossil fuel-based energy supply system to a complete biomass-based economy possible. Gasification of biomass generates a product gas or synthesis gas that can be used to produce SNG and transportation fuels by methanation and Fischer-Tropsch (FT) synthesis, respectively. The objective of the underlying study was to determine the technical and economic feasibility of large-scale systems of co-production of 'green' FT transport fuels and 'green' SNG from biomass.
NTIS
Biomass; Energy Sources

20040110797 Harvard Univ., Cambridge, MA, USA
Analysis of Asian Outflow over the Western Pacific using Observations from Trace-P
Jacob, Daniel J.; August 13, 2004; 7 pp.; In English
Contract(s)/Grant(s): NAG1-2328; No Copyright; Avail: CASI; A02, Hardcopy

Our analysis of the TRACE-P data focused on answering the following questions: 1) How do anthropogenic sources in Asia contribute to chemical outflow over the western Pacific in spring? 2) How does biomass burning in southeast Asia contribute to this outflow? 3) How can the TRACE-P observations be used to better quantify the sources of environmentally important gases in eastern Asia? Our strategy drew on a combination of data analysis and global 3-D modeling, as described below. We also contributed to the planning and execution of TRACE-P through service as mission scientist and by providing chemical model forecasts in the field.
Author
Biomass Burning; Asia; Three Dimensional Models; Emission; Carbon Monoxide; Satellite Observation; Pacific Ocean; Pollution Transport

20040110804 California Univ., Irvine, CA, USA
Regional Chemistry from Global CTMs with EC-Modeled Met-fields for the TRACE-P Mission
Prather, Michael J.; [2003]; 2 pp.; In English
Contract(s)/Grant(s): NAG1-01001; No Copyright; Avail: CASI; A01, Hardcopy

The UC Irvine project for Trace-P (PI: Prather) is a collaboration with Frontier-Japan (Wild and Akimoto) and U. Oslo (Sundet and Isaksen) to make high-resolution global T63 CTM simulations of trace gases and the oxidant budgets for the Trace-P period. Research at FRS and Oslo is not funded by GTE/TRACE-P. Completed control runs for the Trace-P period at T63L40 resolution using the standard emissions with the two related, but independent CTMs at Frontier-UCI and at U. Oslo. Preliminary diagnosis of the impact of Asian emissions on ozone and oxidant budgets is completed. A series of sensitivity runs is beginning to analyze where uncertainty in emissions is related to better simulation of the Trace-P observations.
Author
Atmospheric Composition; Ozone; Environment Pollution; Pollution Transport; Trace Contaminants; Asia

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GEOPHYSICS

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

20040095886 Defence Research and Development Canada, Ottawa, Ontario
The Role of Ionospheric Clutter in Mid-Latitude and Arctic Regions for Assessment of HFSWR Surveillance
Thayaparan, Thayananthan; MacDougall, John; Apr. 2004; 42 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425245; DRDC-TR-2004-093; No Copyright; Avail: CASI; A03, Hardcopy

The ionosphere is the region of the earth's atmosphere in which gases are ionized by radiation such as ultraviolet light from the sun and cosmic rays from outer space. The unwanted radar echoes from the ionosphere are collectively called ionospheric clutter. This paper studies the arctic and mid-latitude ionospheric environment using ionosonde data and assesses

High-Frequency Surface-Wave Radar (HFSWR) surveillance for surface vessels and low-altitude air targets. Although there are various types of ionospheric clutter, in this study we concentrate only on the sporadic-E (Es) ionospheric clutter. The evaluation is based on sporadic- E interference in the HFSWR signal. Our studies show that the Es is reasonably common in the arctic regions. The best time to perform HFSWR surveillance is between approximately 06:00- 15:00 UT and 20:00-00:00 UT. During these hours, the number of days that sporadic-E interference occurs in a month and the range of frequencies reflected is minimized compared to other times of the day. Of the sites considered, Resolute Bay is the most favourable site for HFSWR surveillance in the summer since sporadic-E interference occurs least often, resulting in reduced signal interference. Similarly, Eureka is the preferred site during the winter months. In addition, the ionosphere at Eureka generally reflects the lowest range of maximum frequencies (tilde 4 - 8 MHz), again resulting in less clutter interference. In all the observations, polar cap sites Eureka and Resolute Bay yield results that are less prone to sporadic-E interference than the mid-latitude site Cambridge Bay. The general behaviour of the morphology of polar cap Es that is observed in this study is explained by gravity waves and metallic ions.
DTIC
Arctic Regions; Clutter; Ionospheric Disturbances; Surveillance; Temperate Regions

20040095933 NASA Langley Research Center, Hampton, VA, USA
Atmospheric Ionizing Radiation and Human Exposure
Wilson, J. W.; Goldhagen, P.; Friedberg, W.; DeAngelis, G.; Clem, J. M.; Copeland, K.; Bidasaria, H. B.; July 12, 2004; 21 pp.; In English; 35th COSPAR Scientific Assembly, 18-25 Jul. 2004, Paris, France
Contract(s)/Grant(s): 101-15-01; Copyright; Avail: CASI; A03, Hardcopy

Atmospheric ionizing radiation is of interest, apart from its main concern of aircraft exposures, because it is a principal source of human exposure to radiations with high linear energy transfer (LET). The ionizing radiations of the lower atmosphere near the Earth s surface tend to be dominated by the terrestrial radioisotopes especially along the coastal plain and interior low lands and have only minor contributions from neutrons (11 percent). The world average is substantially larger but the high altitude cities especially have substantial contributions from neutrons (25 to 45 percent). Understanding the world distribution of neutron exposures requires an improved understanding of the latitudinal, longitudinal, altitude and spectral distribution that depends on local terrain and time. These issues are being investigated in a combined experimental and theoretical program. This paper will give an overview of human exposures and describe the development of improved environmental models.
Author
Atmospheric Radiation; Ionizing Radiation; Radiation Sources; Radiation Dosage

20040105566 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Magsat to CHAMP: Magnetic Satellite Explorations of Lithospheric Anomalies over Kursk, Bangui and the Antarctic
Kim, H.; Taylor, Patrick T.; vonFrese, R. R.; Kim, J. W.; [2004]; 2 pp.; In English; Spring AGU Meeting 2004, 17-21 May 2004, Montreal, Queceb, Canada; Copyright; Avail: Other Sources; Abstract Only

We compare crustal magnetic anomaly maps over the Kursk (Russia) and Bangui (Central African Republic) isolated anomalies and the Antarctic derived from the Magsat, \Orsted and CHAMP satellite fields. We wish to demonstrate how progress in satellite magnetic missions has improved the recovery of the crustal magnetic field. The 6-month long Magsat mission of 25 years ago generated two major methods of processing satellite magnetic anomaly data for lithospheric studies. The first was a global perspective using spherical harmonics that emphasize the more regional and global lithospheric fields. However, these fields commonly do not resolve local anomaly features in any detail. Therefore a second procedure involved the use of the individual satellite orbit or track data to recover small-scale anomalies on a regional scale. We present results over prominent magnetic anomalies such as Kursk, Bangui and the large Antarctic continent that demonstrate how the various analysis methods affect the recovery of crustal anomalies. The more recent \Orsted and CHAMP missions are successfully recording data with an improved accuracy and with full spatial and temporal coverage. We show and interpret the total magnetic intensity anomaly maps over these areas from all three satellite magnetometer data sets.
Author
Anomalies; Antarctic Regions; Central African Republic; Lithosphere; Magsat Satellites; Russian Federation; Geodynamics

20040105585 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Magnetic Probing of Core Geodynamics
Voorhies, Coerte V.; [2004]; 1 pp.; In English; Spring 2005 AGU Meeting, 17-21 May 2004, Montreal, Canada; No Copyright; Avail: Other Sources; Abstract Only

To better understand geomagnetic theory and observation, we can use spatial magnetic spectra for the main field and secular variation to test core dynamical hypotheses against seismology. The hypotheses lead to theoretical spectra which are fitted to observational spectra. Each fit yields an estimate of the radius of Earth's core and uncertainty. If this agrees with the seismologic value, then the hypothesis passes the test. A new way to obtain theoretical spectra extends the hydromagnetic scale analysis of Benton to scale-variant field and flow. For narrow scale flow and a dynamically weak field by the top of Earth's core, this yields a generalized Stevenson-McLeod spectrum for the core-source field, and a secular variation spectrum modulated by a cubic polynomial in spherical harmonic degree n. The former passes the tests. The latter passes many tests, but does not describe rapid dipole decline and quadrupole rebound; some tests suggest it is a bit hard, or rich in narrow scale range. In a core geodynamo, motion of the fluid conductor does work against the Lorentz force. This converts kinetic into magnetic energy which, in turn, is lost to heat via Ohmic dissipation. In the analysis at length-scale 1/k, if one presumes kinetic energy is converted in either eddy-overturning or magnetic free-decay time-scales, then Kolmogorov or other spectra in conflict with observational spectra can result. Instead, the rate work is done roughly balances the dissipation rate, which is consistent with small-scale flow. The conversion time-scale depends on dynamical constraints. These are summarized by the magnetogeostrophic vertical vorticity balance by the top of the core, which includes anisotropic effects of rotation, the magnetic field, and the core-mantle boundary. The resulting theoretical spectra for the core-source field and its SV are far more compatible with observation. The conversion time-scale of order 120 years is pseudo-scale-invariant. Magnetic spectra of other planets may differ; however, if a transition to non-conducting fluid hydrogen in Jupiter acts as a barrier to vertical flow, as well as current, then the shape of the jovi-magnetic spectrum could be remarkably Earth-like.
Author
Earth Core; Magnetic Measurement; Geodynamics

20040105621 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Influence of the Several Very Large Solar Proton Events in Years 2000-2003 on the Neutral Middle Atmosphere
Jackman, Charles H.; Sinnhuber, Miriam; Anderson, John; McPeters, Richard D.; FLeming, Eric L.; Russell, James M.; [2004]; 1 pp.; In English; COSPAR Meeting, 18-25 Jul. 2004, Paris, France; No Copyright; Avail: Other Sources; Abstract Only

Solar proton events (SPEs) are known to have caused changes in constituents in the Earth's neutral middle atmosphere. The highly energetic protons produce ionizations, excitations, dissociations, and dissociative ionizations of the background constituents, which lead to the production of HOx (H, OH, HO2) and NOy (N, NO, NO2, NO3, N2O5, HNO3, HO2NO2, ClONO2, BrONO2). The HOx increases lead to short-lived ozone decreases in the mesosphere and upper stratosphere due to the short lifetimes of the HOx constituents. The NOy increases lead to long-lived stratospheric ozone changes because of the long lifetime of the NOy family in this region. The past four years, 2000-2003, have been replete with SPEs and huge fluxes of high energy protons occurred in July and November 2000, September and November 2001, April 2002, and October 2003. Smaller, but still substantial, proton fluxes impacted the Earth during other months from year 2000 to 2003. The Goddard Space Flight Center (GSFC) Two-dimensional (2D) Model was used in computing the influence of the SPEs. The impact of these extremely large SPEs was calculated to be especially large in the upper stratosphere and mesosphere. The results of the GSFC 2D Model will be shown along with comparisons to the Upper Atmosphere Research Satellite (UARS) Halogen Occultation Experiment (HALOE) and Solar Backscatter Ultraviolet 2 (SBUV/2) instruments.
Author
Earth Atmosphere; Middle Atmosphere; Neutral Atmospheres; Solar Protons; Annual Variations

20040105659 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Testing the PV-Theta Mapping Technique in a 3-D CTM Model Simulation
Frith, Stacey M.; [2004]; 1 pp.; In English; International Quadrennial Ozone Symposium (QOS 2004), 1-8 Jun. 2004, Kos, Greece; No Copyright; Avail: Other Sources; Abstract Only

Mapping lower stratospheric ozone into potential vorticity (PV)- potential temperature (Theta) coordinates is a common technique employed to analyze sparse data sets. Ozone transformed into a flow-following dynamical coordinate system is insensitive to meteorological variations. Therefore data from a wide range of times/locations can be compared, so long as the measurements were made in the same airmass (as defined by PV). Moreover, once a relationship between ozone and PV/Theta is established, a full 3D ozone field can be estimated from this relationship and the 3D analyzed PV field. However, ozone data mapped in this fashion can be hampered by noisy PV fields, or 'mis-matches' in the resolution and/or exact location of the ozone and PV measurements. In this study, we investigate the PV-ozone relationship using output from a recent 50-year run of the Goddard 3D chemical transport model (CTM). Model constituents are transported using off-line dynamics from the finite volume general circulation model (FVGCM). By using the internally consistent model PV and ozone fields, we minimize

noise due to mis-matching and resolution issues. We calculate correlations between model ozone and PV throughout the stratosphere, and test the sensitivity of the technique to initial data resolution. To do this we degrade the model data to that of various satellite instruments, then compare the mapped fields derived from the sub-sampled data to the full resolution model data. With these studies we can determine appropriate limits for the PV-theta mapping technique in latitude, altitude, and as a function of original data resolution.
Author
Ozone; Simulation; Three Dimensional Models; Mapping; Vorticity; Stratosphere

20040110227 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Satellite Geopotential Anomaly Constraints for the Crust of the Greenland-Iceland Region
vonFrese, R. R.; Leftwich, T. E.; Kim, H.; Taylor, Patrick T.; Kim, J.; [2004]; 2 pp.; In English; Spring AGU Meeting 2004, 17-21 May 2004, Montreal, Quebec, Canada; No Copyright; Avail: Other Sources; Abstract Only

Satellite magnetometer observations of the Greenland-Iceland region compare quite well with lower altitude data. The satellite magnetic data suggest magnetically enhanced crust was emplaced by the Iceland Plume. Crustal thicknesses, which may be more than 30 km for the Greenland-Scotland Ridge, were obtained from inversion of the compensating terrain gravity effects that were estimated by spectral correlation analysis of the free-air gravity anomalies and terrain gravity effects. Regional magnetic anomaly maxima overlie possible thickened crust from eastern Iceland to the Greenland Coast. The Iceland-Faroe Ridge may involve thinner crust than the Greenland-Iceland portion of the Greenland-Scotland Ridge. The gravity derived crustal model exceeds a 0.7 correlation with available seismic estimates. In thermally active areas our gravity Moho estimates are systematically deeper than the seismic estimates suggesting local density reductions of the underlying lower crust/upper mantle. In south central Greenland, on the other hand, the gravity Moho estimates are shallower than seismic estimates to suggest a local enhancement of the lower crust/upper mantle density. The dichotomous crust of the Greenland-Iceland and Iceland-Faroe Ridges suggests unequal crustal development by the Iceland Plume and the Mid-Atlantic Ridge, where more crustal material may have been contributed to the North Atlantic Plate than the Eurasian Plate. A new thermal modeling scheme based on Poisson's relation between point pole gravity and thermal potentials allows estimation of magnetic crustal thicknesses. Subsequent magnetic anomaly inversion for susceptibility contrasts infers crustal development of the Greenland-Scotland Ridge by temporally variable pulses in plume strength.
Author
Crusts; Geopotential; Greenland; Iceland; Magnetometers; Gravity Anomalies; Satellite Observation

20040110278 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Crustal Deformation and the Seismic Cycle across the Kodiak Islands, Alaska
Sauber, Jeanne; Carver, G.; Cohen, Steven C.; King, Robert; [2004]; 2 pp.; In English; AGU Spring 2004 Joint Assembly, 17-21 May 2004, Montreal, Quebec, Canada; Copyright; Avail: Other Sources; Abstract Only

The Kodiak Islands are located approximately 130 to 250 km from the Alaska-Aleutian Trench where the Pacific plate is underthrusting the North American plate at a rate of about 57 mm/yr. The southern extent of the 1964 Prince William Sound (${M-w}$ = 9.2) earthquake rupture occurred offshore and beneath the eastern portion of the Kodiak Islands. Here we report GPS results (1993-2001) from northern Kodiak Island that span the transition between the 1964 uplift region along the eastern coast and the region of coseismic subsidence further inland. The horizontal velocity vectors range from 22.9 $\pm$ 2.2 mm/yr at N26.3$\deg$W $\pm$ 2.5$\deg$, about 150 km from the trench, to 5.9 $\pm$ 1.3 mm/yr at N65.9$\deg$W $\pm$ 6.6$\deg$, about 190 km from the trench. Near the northeastern coast of Kodiak the velocity vector above the shallow, locked main thrust zone is between the orientation of PCFC-NOAM plate motion (N22$/deg$W) and the trench-normal (N3O$\deg$W). Further west, our geodetic results suggest the accumulation of shear strain that will be released eventually as left-lateral motion on upper plate faults such as the Kodiak Island fault. These results are consistent with the hypothesis that the difference between the Pacific-North American plate motion and the orientation of the down going slab would lead to 4-8 mm/yr of left-lateral slip. Short-term geodetic uplift rates range from 2 - 14 mm/yr, with the maximum uplift located near the axis of maximum subsidence during the 1964 earthquake. We evaluated alternate interseismic models for Kodiak to test the importance of various mechanisms responsible for crustal deformation rates. These models are based on the plate interface slip history inferred from earlier modeling of coseismic and post-seismic geodetic results. The horizontal (trench perpendicular) and vertical deformation rates across Kodiak are consistent with a model that includes the viscoelastic response to : (1) a downgoing Pacific plate interface that is locked at shallow depths,(2) coseismic slip in the 1964 and (3) interseismic creep below the seismogenic zone. The change in orientation of the horizontal velocity vector occurs down-dip from the locked main thrust zone. In southern Kodiak, the coseismic slip in the 1964 earthquake was smaller than in the northern Kodiak region; yet, the horizontal, interseismic velocities as a function of distance from the trench are comparable to those

in northern Kodiak. Based on the earthquake history prior to, and following the 1964 earthquake, we hypothesize that the plate interface in southern Kodiak slips in more frequent large earthquakes than in northern Kodiak.
Author
Earthquakes; Geodesy; Seismology; Aleutian Islands (US); Alaska; Plates (Tectonics); Tectonics

20040110421 NASA Langley Research Center, Hampton, VA, USA
Transport Pathways for Asian Pollution Outflow Over the Pacific: Interannual and Seasonal Variations
Liu, Hong-Yu; Jacob, Daniel J.; Bey, Isabelle; Yantosca, Robert M.; Duncan, Bryan N.; Sachse, Glen W.; Journal of Geophysical Research; 2003; ISSN 0148-0227; Volume 108, No. D20, pp. 7-1 - 7-15; In English
Contract(s)/Grant(s): NAG1-2328; Copyright; Avail: Other Sources

The meteorological pathways contributing to Asian pollution outflow over the Pacific are examined with a global three-dimensional model analysis of CO observations from the Transport and Chemical Evolution over the Pacific (TRACE-P) aircraft mission (February-April 2001). The model is used also to place the TRACE-P observations in an interannual (1994-2001) and seasonal context. The major process driving Asian pollution outflow in spring is frontal lifting ahead of southeastward-moving cold fronts (the leading edge of cold surges) and transport in the boundary layer behind the cold fronts. Orographic lifting over central and eastern China combines with the cold fronts to promote the transport of Chinese pollution to the free troposphere. Outflow of seasonal biomass burning in Southeast Asia during spring takes place mostly by deep convection but also by northeastward transport and frontal lifting, mixing with the anthropogenic outflow. Boundary layer outflow over the western Pacific is largely devoid of biomass burning influence. European and African (biomass burning) plumes in Asian outflow during TRACE-P were weak (less than 60 ppbv and 20 ppbv CO, respectively) and were not detectable in the observations because of superposition of the much larger Asian pollution signal. Spring 2001 (La Nina) was characterized by unusually frequent cold surge events in the Asian Pacific rim and strong convection in Southeast Asia, leading to unusually strong boundary layer outflow of anthropogenic emissions and convective outflow of biomass burning emissions in the upper troposphere. The Asian outflow flux of CO to the Pacific is found to vary seasonally by a factor of 3-4 (maximum in March and minimum in summer). The March maximum results from frequent cold surge events and seasonal biomass burning emissions.
Author
Annual Variations; Pollution; Pacific Ocean; Three Dimensional Models; Topography; Southeast Asia; Meteorology

20040110495 Scripps Institution of Oceanography, La Jolla, CA
Analytic Support of the Phillips Lab Whole Sky Imager, 1997-2001
Shields, Janet E.; Karr, Monette E.; Burden, Art R.; Johnson, Richard W.; Baker, Justin G.; Aug. 2002; 31 pp.; In English
Contract(s)/Grant(s): N00014-97-C-0385
Report No.(s): AD-A425323; No Copyright; Avail: CASI; A03, Hardcopy

During this time, repairs were performed as needed, and software upgrades were delivered. A means of providing a very accurate assignment of the angular location (in object space) of each pixel (in image space) was developed and delivered. A first generation night algorithm, for identifying the presence of clouds in a starlight image, was developed. Preliminary work toward extending these techniques toward determination of earth-to-space beam transmittance was begun, and is continuing under follow-on funding. This work has enabled the Air Force to continue many productive years of using the WSI in a variety of test-support scenarios.
DTIC
Algorithms

20040110513 Scripps Institution of Oceanography, La Jolla, CA
Analysis and Measurement of Cloud Free Line of Sight and Related Cloud Statistical Behavior
Shields, Janet E.; Karr, Monette E.; Burden, Art R.; Johnson, Richard W.; Baker, Justin G.; Jun. 2003; 16 pp.; In English
Contract(s)/Grant(s): N00014-97-D-0350
Report No.(s): AD-A425400; No Copyright; Avail: CASI; A03, Hardcopy

The Atmospheric Optics Group at the Marine Physical Lab, Scripps Institution of Oceanography, University of California San Diego, has been developing Whole Sky Imagers (WSI) for many years. A Day/Night WSI which had 24-hour a day capability was initially developed in the early 1990's, and has been significantly upgraded in capability since that time. One

of these instruments, Day/Night WSI Unit 2, was delivered to the Air Force Starfire Optical Range. This work was funded by the Air Force Phillips Lab under Contract N00014-89-D-0142 DO #18.
DTIC
Cloud Physics; Detection; Line of Sight; Optical Measurement

20040110691 Westinghouse Savannah River Co., Aiken, SC, USA
Potential Enhancement of the Saltstone Inadvertent Intruder Analysis
Wilhite, E. L.; Mar. 28, 2003; In English
Report No.(s): DE2004-810993; WSRC-RP-2003-00329; No Copyright; Avail: National Technical Information Service (NTIS)

In 2002, a Special Analysis (SA) was conducted to develop radionuclide disposal limits for low curie salt and other salt wastes in the Saltstone Disposal Facility (SDF). This Special Analysis was done to update the Saltstone Performance Assessment (PA), which had assumed that only waste from the In-Tank Precipitation process and the Effluent Treatment Facility would be disposed in Saltstone and to address requirements of the new DOE Waste Management Order.
NTIS
Salts; Effluents; Radioactive Wastes

20040110696 NASA Langley Research Center, Hampton, VA, USA
Characterization of Transport Errors in Chemical Forecasts from a Global Tropospheric Chemical Transport Model
Bey, I.; Jacob, D. J.; Liu, H.; Yantosca, R. M.; Sachse, G. W.; [2004]; 37 pp.; In English
Contract(s)/Grant(s): NAG1-2328; Copyright; Avail: CASI; A03, Hardcopy

We propose a new methodology to characterize errors in the representation of transport processes in chemical transport models. We constrain the evaluation of a global three-dimensional chemical transport model (GEOS-CHEM) with an extended dataset of carbon monoxide (CO) concentrations obtained during the Transport and Chemical Evolution over the Pacific (TRACE-P) aircraft campaign. The TRACEP mission took place over the western Pacific, a region frequently impacted by continental outflow associated with different synoptic-scale weather systems (such as cold fronts) and deep convection, and thus provides a valuable dataset. for our analysis. Model simulations using both forecast and assimilated meteorology are examined. Background CO concentrations are computed as a function of latitude and altitude and subsequently subtracted from both the observed and the model datasets to focus on the ability of the model to simulate variability on a synoptic scale. Different sampling strategies (i.e., spatial displacement and smoothing) are applied along the flight tracks to search for systematic model biases. Statistical quantities such as correlation coefficient and centered root-mean-square difference are computed between the simulated and the observed fields and are further inter-compared using Taylor diagrams. We find no systematic bias in the model for the TRACE-P region when we consider the entire dataset (i.e., from the surface to 12 km). This result indicates that the transport error in our model is globally unbiased, which has important implications for using the model to conduct inverse modeling studies. Using the First-Look assimilated meteorology only provides little improvement of the correlation, in comparison with the forecast meteorology. These general statements can be refined when the entire dataset is divided into different vertical domains, i.e., the lower troposphere (less than 2 km), the middle troposphere (2-6 km), and the upper troposphere (greater than 6 km). The best agreement between the observations and the model is found in the lower and middle troposphere. Downward displacements in the lower troposphere provide a better fit with the observed value, which could indicate a problem in the representation of boundary layer height in the model. Significant improvement is also found for downward and southward displacements in the upper troposphere. There are several potential sources of errors in our simulation of the continental outflow in the upper troposphere which could lead to such biases, including the location and/or the strength of deep convective cells as well as that of wildfires in Southeast Asia.
Author
Troposphere; Three Dimensional Models; Characterization; Transport Theory; Error Analysis; Chemical Evolution; Geosat Satellites

20040110725 NASA Langley Research Center, Hampton, VA, USA
Transport and Chemical Evolution over the Pacific (TRACE-P)Aircraft Mission: Design, Execution, and First Results
Jacob, Daniel J.; Crawford, James H.; Kleb, Mary M.; Connors, Vickie S.; Bendura, Richard J.; Raper, James L.; Sachse, Glen W.; Gille, John C.; Emmons, Louisa; Heald, Colette L.; Journal of Geophysical Research; 2003; ISSN 0148-0227; Volume 108, No. D20, pp. 2-1 - 2-19; In English
Contract(s)/Grant(s): NAG1-2328; Copyright; Avail: Other Sources

The NASA Transport and Chemical Evolution over the Pacific (TRACE-P) aircraft mission was conducted in February-April 2001 over the NW Pacific (1) to characterize the Asian chemical outflow and relate it quantitatively to its sources and (2) to determine its chemical evolution. It used two aircraft, a DC-8 and a P-3B, operating out of Hong Kong and Yokota Air Force Base (near Tokyo), with secondary sites in Hawaii, Wake Island, Guam, Okinawa, and Midway. The aircraft carried instrumentation for measurements of long-lived greenhouse gases, ozone and its precursors, aerosols and their precursors, related species, and chemical tracers. Five chemical transport models (CTMs) were used for chemical forecasting. Customized bottom-up emission inventories for East Asia were generated prior to the mission to support chemical forecasting and to serve as a priori for evaluation with the aircraft data. Validation flights were conducted for the Measurements Of Pollution In The Troposphere (MOPITT) satellite instrument and revealed little bias (6 plus or minus 2%) in the MOPITT measurements of CO columns. A major event of transpacific Asian pollution was characterized through combined analysis of TRACE-P and MOPITT data. The TRACE-P observations showed that cold fronts sweeping across East Asia and the associated warm conveyor belts (WCBs) are the dominant pathway for Asian outflow to the Pacific in spring. The WCBs lift both anthropogenic and biomass burning (SE Asia) effluents to the free troposphere, resulting in complex chemical signatures. The TRACE-P data are in general consistent with a priori emission inventories, lending confidence in our ability to quantify Asian emissions from socioeconomic data and emission factors. However, the residential combustion source in rural China was found to be much larger than the a priori, and there were also unexplained chemical enhancements (HCN, CH3Cl, OCS, alkylnitrates) in Chinese urban plumes. The Asian source of CCl4 was found to be much higher than government estimates. Measurements of HCN and CH3CN indicated a dominant biomass burning source and ocean sink for both gases. Large fractions of sulfate and nitrate were found to be present in dust aerosols. Photochemical activity in the Asian outflow was strongly reduced by aerosol attenuation of UV radiation, with major implications for the concentrations of HOx, radicals. New particle formation, apparently from ternary nucleation involving NH3, was observed in Chinese urban plumes.
Author
Chemical Evolution; Pacific Ocean; NASA Space Programs; Photochemical Reactions

20040110727 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Gravity Wave Forcing of the Mesosphere and Lower Thermosphere: Mountain and Convective Waves Ascending Vertically (MaCWAVE)
Fritts, David C.; September 08, 2004; 7 pp.; In English
Contract(s)/Grant(s): NASW-01075
Report No.(s): NWRA-CoRA-04-R283; No Copyright; Avail: CASI; A02, Hardcopy

The specific objectives of this research effort included the following: 1) Quantification of gravity wave propagation throughout the lower and middle atmosphere in order to define the roles of topographic and convective sources and filtering by mean and low-frequency winds in defining the wave field and wave fluxes at greater altitudes; 2) The influences of wave instability processes in constraining wave amplitudes and fluxes and generating turbulence and transport; 3) Gravity wave forcing of the mean circulation and thermal structure in the presence of variable motion fields and wave-wave interactions, since the mean forcing may be a small residual when wave interactions, anisotropy, and momentum and heat fluxes are large; 4) The statistical forcing and variability imposed on the thermosphere at greater altitudes by the strong wave forcing and interactions occurring in the MLTI.
Author
Gravity Waves; Mesosphere; Thermosphere

20040110805 NASA Langley Research Center, Hampton, VA, USA
Eastern Asian Emissions of Anthropogenic Halocarbons Deduced from Aircraft Concentration Data
Palmer, Paul I.; Jacob, Daniel J.; Mickle, Loretta, J.; Blake, Donald R.; Sachse, Glen W.; Fuelberg, Henry E.; Kiley, Christopher M.; Journal of Geophysical Research; 2003; ISSN 0148-0227; Volume 108, No. D24, pp. 2-1 - 3-4; In English
Contract(s)/Grant(s): NAG1-2328; Copyright; Avail: Other Sources

The Montreal Protocol restricts production of ozone-depleting halocarbons worldwide. Enforcement of the protocol has relied mainly on annual government statistics of production and consumption of these compounds (bottom-up approach). We show here that aircraft observations of ha1ocarbon:CO enhancement ratios on regional to continental scales can be used to infer halocarbon emissions, providing independent verification of the bottom-up approach. We apply this topdown approach to aircraft observations of Asian outflow &om the TRACE-P mission over the western Pacific (March-April 2001) and derive emissions from eastern Asia (China, Japan, and Korea). We derive an eastern Asian carbon tetrachloride (CCl4) source of 21.5 Gg yr(sup -1), several-fold larger than previous estimates and amounting to -30% of the global budget for this gas. Our emission estimate for CFC-11 from eastern Asia is 50% higher than inventories derived from manufacturing records. Our

emission estimates for methyl chloroform (CH3CC13) and CFC-12 are in agreement with existing inventories. For halon 1211 we find only a strong local source originating from the Shanghai area. Our emission estimates for the above gases result in a approximately equal to 40% increase in the ozone depletion potential (ODP) of Asian emissions relative to previous estimates, corresponding to a approximately equal to 10% global increase in ODP.
Author
Asia; Emission; Carbon Compounds; Chemical Evolution; Halogen Compounds; Transport Aircraft

20040110866 Colorado Univ., Boulder, CO, USA
Karhunen-Loeve Analysis of SCIGN GPS Data
Rundle, John B.; Tiampo, Kristy; Gross, Susanna; [2004]; 19 pp.; In English
Contract(s)/Grant(s): SENH99-0186-0162; No Copyright; Avail: CASI; A03, Hardcopy

During the final year of this project, we made substantial progress on the proposed work. Specifically, we have continued the horizontal and vertical Karhunen-Loeve (KL) analysis of SCIGN data and implemented the study of a number of particular modes. In particular, we studied the spatial and temporal interactions of these modes in an effort to better understand and model the source of each signal.
Author
Karhunen-Loeve Expansion; Geological Faults; Mapping; Stress Analysis

20040110876 California Univ., Los Angeles, CA, USA
Magnetosphere-Ionosphere Coupling in the Auroral Zone
Schriver, David; January 2004; 5 pp.; In English
Contract(s)/Grant(s): NAG5-10473; No Copyright; Avail: CASI; A01, Hardcopy

The visual light display at high latitudes referred to as the aurora fascinates casual observers and researchers alike. The natural question is what causes the aurora? We know that energized electrons streaming along the Earth's ambient magnetic field and colliding with atmospheric particles produce aurora. We do not know for certain, however, how these electrons are accelerated to high energies primarily in the field-aligned direction toward the Earth, or what the drivers of this acceleration are. As such, the goal of this Guest Investigator research project was to examine the physical processes that can cause field-aligned acceleration of plasma particles in the auroral region.
Author
Magnetosphere-Ionosphere Coupling; Auroral Zones

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METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

20040095902 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Validation of Version 8 Ozone Profiles: Is SBUV Ready for Prime Time?
McPeters, R. D.; Wellemeyer, C. G.; Ahn, C.; [2004]; 1 pp.; In English; International Quadrennial Ozone Symposium, 1-8 Jun. 2004, Kos, Greece; No Copyright; Avail: Other Sources; Abstract Only

Ozone profile data are now available from a series of BUV instruments - SBUV on Nimbus 7 and SBW/2 instruments on NOAA 9, NOAA 11, and NOAA 16. The data have been processed through the new version 8 algorithm, which is designed to be more accurate and, more importantly, to reduce the influence of the a priori on ozone trends. As a part of the version 8 reprocessing we have attempted to apply a consistent calibration to the individual instruments so that their data records can be used together in a time series analysis. Validation consists of examining not only the mean difference from external datasets (i.e trends) but also consistency in the interannual variability of the data. Here we validate the v8 BUV data through comparison with ECC sondes, lidar and microwave measurements, and with SAGE II and HALOE satellite data records. We find that individual profiles generally agree with external data sets within +/-10% between 30 hPa and 1 hPa (approx. 24 - 50 km) and frequently agree within +/-5%. The interannual variability of the BUV ozone time series agrees well with that of SAGE II . On the average, different B W instruments usually agree within +/-5% with each other, though the relative error increases near the ends of the Nimbus 7 and NOAA 16 data records as a result of instrument problems. The combined v8 BUV

data sets cover the 1979-2003 time period giving daily global coverage of the ozone vertical distribution to better accuracy than has ever been possible before.
Author
Noaa 11 Satellite; Noaa 9 Satellite; Ozone; Radar Measurement; Time Series Analysis; Ultraviolet Radiation; Vertical Distribution

20040095903 NASA Goddard Space Flight Center, Greenbelt, MD, USA, Maryland Univ. Baltimore County, Catonsville, MD, USA
Rain Reevaporation, Boundary Layer Convection Interactions, and Pacific Rainfall Patterns in an AGCM
Bacmeister, Julio T.; Suarez, Max J.; Robertson, Franklin R.; [2004]; 43 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Sensitivity experiments with an atmospheric general circulation model (AGCM) show that parameterized rain re-evaporation has a large impact on simulated precipitation patterns in the tropical Pacific, especially on the configuration of the model s intertropical convergence zone (ITCZ). Weak re-evaporation leads t o the formation of a 'double ITCZ' during the northern warm season. The double ITCZ is accompanied by strong coupling between precipitation and high-frequency vertical motion in the planetary boundary layer (PBL). Strong reevaporation leads to a better overall agreement of simulated precipitation with observations. The model s double ITCZ bias is reduced. At the same time, correlation between high-frequency vertical motion in the PBL and precipitation is reduced. Experiments with modified physics suggest that evaporative cooling by rain near the PBL top weakens the coupling between precipitation and vertical motion. This may reduce the model s tendency to form double ITCZs. The strength of high-frequency vertical motions in the PBL was also reduced directly through the introduction of a diffusive cumulus momentum transport (DCMT) parameterization. The DCMT had a visible impact on simulated precipitation in the tropics, but did not reduce the model s double bias in all cases.
Author
Atmospheric General Circulation Models; Rain; Tropical Regions; Boundary Layers; Evaporative Cooling

20040095923 NASA Langley Research Center, Hampton, VA, USA
Surface Emissivity Derived From Multispectral Satellite Data
Minnis, P.; Smith, W. L., Jr.; Young, D. F.; [1998]; 5 pp.; In English
Contract(s)/Grant(s): DE-AI05-95ER-61992; No Copyright; Avail: CASI; A01, Hardcopy

Surface emissivity is critical for remote sensing of surface skin temperature and infrared cloud properties when the observed radiance is influenced by the surface radiation. It is also necessary to correctly compute the longwave flux from a surface at a given skin temperature. Surface emissivity is difficult to determine because skin temperature is an ill-defined parameter. The surface-emitted radiation may arise from a range of surface depths depending on many factors including soil moisture, vegetation, surface porosity, and heat capacity. Emissivity can be measured in the laboratory for pure surfaces. Transfer of laboratory measurements to actual Earth surfaces, however, is fraught with uncertainties because of their complex nature. This paper describes a new empirical approach for estimating surface skin temperature from a combination of brightness temperatures measured at different infrared wavelengths with satellite imagers. The method uses data from the new Geostationary Operational Environmental Satellite (GOES) imager to determine multispectral emissivities from the skin temperatures derived over the ARM Southern Great Plains domain.
Author
Surface Temperature; Emissivity; Remote Sensing; Infrared Spectra

20040095935 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Vertical Profiles of Latent Heat Release over the Global Tropics using TRMM Rainfall Products from December 1997 to November 2002
Tao, W.-K.; Lang, S.; Simpson, J.; Meneghini, R.; Halverson, J.; Johnson, R.; Adler, R.; [2003]; 1 pp.; In English; International Latent Heat Meeting, 2 Sep. 2003, Tokyo, Japan; No Copyright; Avail: CASI; A01, Hardcopy

NASA Tropical Rainfall Measuring Mission (TRMM) precipitation radar (PR) derived rainfall information will be used to estimate the four-dimensional structure of global monthly latent heating and rainfall profiles over the global tropics from December 1997 to November 2000. Rainfall, latent heating and radar reflectivity structures between El Nino (DJF 1997-98) and La Nina (DJF 1998-99) will be examined and compared. The seasonal variation of heating over various geographic locations (i.e., oceanic vs continental, Indian ocean vs west Pacific, Africa vs. S. America) will also be analyzed. In addition, the relationship between rainfall, latent heating (maximum heating level), radar reflectivity and SST is examined and will be

presented in the meeting. The impact of random error and bias in stratiform percentage estimates from PR on latent heating profiles is studied and will also be presented in the meeting. The Goddard Cumulus Ensemble Model is being used to simulate various mesoscale convective systems that developed in different geographic locations. Specifically, the model estimated rainfall, radar reflectivity and latent heating profiles will be compared to observational data collected from TRMM field campaigns over the South China Sea in 1998 (SCSMEX), Brazil in 1999 (TRMM-LBA), and the central Pacific in 1999 (KWAJEX). Sounding diagnosed heating budgets and radar reflectivity from these experiments can provide the means to validate (heating product) as well as improve the GCE model. Review of other latent heating algorithms will be discussed in the workshop.
Author
Latent Heat; Rain; Trmm Satellite; Algorithms; Precipitation (Meteorology); Tropical Regions; Annual Variations

20040095942 NASA Langley Research Center, Hampton, VA, USA
The Stratospheric Aerosol and Gas Experiment (SAGE III)
Thomason, Larry W.; [1998]; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Three SAGE III instruments are being built by Ball Aerospace & Technologies Corporation in Boulder, Colorado (USA). SAGE III is a fourth generation instrument that incorporates robust elements of its predecessors [SAM II, SAGE, SAGE II] while incorporating new design elements. The first of these will be launched aboard a Russian Meteor/3M platform in May 1999. SAGE III will add measurements of O2-A band from which density and temperature profiles are retrieved. This feature should improve refraction and Rayleigh computations over earlier. Additionally, the linear array of detectors will permit on-orbit wavelength calibration from observations of the exo-atmospheric solar Fraunhofer spectrum.
Derived from text
Satellite Instruments; Solar Spectra; Temperature Profiles

20040100692 National Oceanic and Atmospheric Administration, Rockville, MD
New Priorities for the 21st Century. NOAA's Strategic Plan for FY2003-FY2008 and Beyond
Mar. 2003; 28 pp.; In English
Report No.(s): PB2004-106967; No Copyright; Avail: CASI; A03, Hardcopy

The 21st century poses complex challenges for the National Oceanic and Atmospheric Administration (NOAA). Every aspect of NOAA's mission--ranging from managing coastal and marine resources to predicting changes in the Earth's environment--faces a new urgency, given intensifying national needs related to the economy, the environment, and public safety. As the new century unfolds, new priorities for NOAA action are emerging in the areas of climate change, freshwater supply, ecosystem management, and homeland security. This Strategic Plan is NOAA's response to all of these challenges. It forges a path for meeting the needs of America today and addressing the critical issues of tomorrow. It responds to the Presidents Management Agenda for a citizen-centered, performance-driven organization that serves every American every day. And it provides a blueprint for ensuring value and corporate accountability in NOAA's daily operations, and for improving NOAA's services--and the benefits from our services--to all Americans.
NTIS
Ecosystems; Marine Resources; Climate Change; Predictions

20040100729 NASA Langley Research Center, Hampton, VA, USA
Evaluation of Time-Averaged CERES TOA SW Product Using CAGEX Data
Carlson, Ann B.; Wong, Takmeng; [1998]; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A major component in the analysis of the Earth's radiation budget is the recovery of daily and monthly averaged radiative parameters using noncontinuous spatial and temporal measurements from polar orbiting satellites. In this study, the accuracy of the top of atmosphere (TOA) shortwave (SW) temporal interpolation model for the Clouds and the Earth's Radiant Energy System (CERES) is investigated using temporally intensive half-hourly TOA fluxes from the CERES/ARM/GEWEX Experiment (CAGEX) over Oklahoma (Charlock et al., 1996).
Derived from text
Clouds (Meteorology); Earth Radiation Budget; Short Wave Radiation; Hydrological Cycle; Energy Distribution; Data Acquisition

20040100795 NASA Langley Research Center, Hampton, VA, USA
The Use of Correlated k-Distributions to Account for the Radiative Effect of Molecular Absorption Upon Satellite Measured Radiances
Kratz, David P.; [1998]; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Establishing the radiative effect of molecular absorption (emission) in the atmosphere is critical to the proper interpretation of satellite retrieved radiances. Without an accurate accounting for molecular absorption, the assignment of radiative transfer processes to observed radiative effects could be fraught errors. Moreover, since the spectral characteristics of molecular absorption can change quickly with wavenumber, the adaptation of climate model parameterizations has the potential to lead to dubious results unless the chosen spectral range corresponds closely to the response function of the satellite instrument. Thus, an initiative has been undertaken to construct parameterizations that will account for the molecular absorption found in the spectral ranges of several satellite radiometers. Because of its efficiency and accuracy in calculating the molecular absorption for nonhomogeneous paths, the correlated k-distribution procedure has proven to be the most effective parameterization (Fu and Liou, 1992, and Kratz, 1995). A further advantage of the correlated k- distribution procedure is its ability to be incorporated directly into multiple scattering routines that consider scattering, as well as absorption, by clouds and aerosol particles.
Author
Molecular Absorption; Radiance; Satellite Instruments; Parameterization; Clouds (Meteorology); Climate Models

20040105660 NASA Goddard Space Flight Center, Greenbelt, MD, USA
SHADOZ (Southern Hemisphere Additional Ozonesondes): A Project Overview and New Insights on Tropical Tropospheric Ozone
Thompson, Anne M.; Witte, Jacquelyn C.; Oltmans, S. J.; Schmidlin, F. J.; [2004]; 1 pp.; In English; International Quadrennial Ozone Symposium, 1-8 Jun. 2004, Kos, Greece; No Copyright; Avail: Other Sources; Abstract Only

The SHADOZ (Southern Hemisphere Additional Ozonesondes) ozone sounding network was initiated in 1998 to improve the coverage of tropical in-situ ozone measurements for satellite validation, algorithm development and related process studies. Over 2000 soundings have been archived at the website, http://croc.gsfc.nasa.gov/shadoz, for 12 stations: Ascension Island; Nairobi and Malindi, Kenya; Irene, South Africa; Reunion Island; Watukosek, Java; Fiji; Tahiti; American Samoa; San Cristobal, Galapagos; Natal, Brazil; Paramaribo, Surinam. Key results from SHADOZ will be described from among the following: 1) By using ECC sondes with similar procedures, 5-10% accuracy and precision (1-sigma) of the sonde total ozone measurement is achieved; 2) Week-to-week variability in tropospheric ozone is so great that statistics are frequently not Gaussian; most stations vary up to a factor of 3 in tropospheric column over the course of a year; 3) Longitudinal variability in tropospheric ozone profiles is a consistent feature, with a 10-15 DU column-integrated difference between Atlantic and Pacific sites; this causes a 'zonal wave-one' feature in total ozone; 4) The ozone record from Paramaribo, Surinam (6N, 55W) is a marked contrast to southern tropical ozone because Surinam is often north of the Intertropical Convergence Zone.
Author
Sondes; Ozonometry; Southern Hemisphere

20040110245 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Trend and Variability of China Precipitation in Spring and Summer: Linkage to Sea Surface Temperatures
Yang, Fanglin; Lau, K.-M.; [2004]; 43 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Observational records in the past 50 years show an upward trend of boreal-summer precipitation over central eastern China and a downward trend over northern China. During boreal spring, the trend is upward over southeastern China and downward over central eastern China. This study explores the forcing mechanism of these trends in association with the global sea-surface temperature (SST) variations on the interannual and inter-decadal timescales. Results based on Singular Value Decomposition analyses (SVD) show that the interannual variability of China precipitation in boreal spring and summer can be well defined by two centers of actions for each season, which are co-varying with two interannual modes of SSTs. The first SVD modes of precipitation in spring and summer, which are centered in southeastern China and northern China, respectively, are linked to an ENSO-like mode of SSTs. The second SVD modes of precipitation in both seasons are confined to central eastern China, and are primarily linked to SST variations over the warm pool and Indian Ocean. Features of the anomalous 850-hPa winds and 700-Wa geopotential height corresponding to these modes support a physical mechanism that explains the causal links between the modal variations of precipitation and SSTs. On the decadal and longer timescale, similar causal links are found between the same modes of precipitation and SSTs, except for the case of springtime precipitation over central eastern China. For this case, while the interannual mode of precipitation is positively correlated with the interannual variations of SSTs over the warm pool and Indian Ocean; the inter-decadal mode is negatively correlated with a different SST mode, the North Pacific mode. The later is responsible for the observed downward trend of springtime precipitation over central eastern China. For all other cases, both the interannual and inter-decadal variations of precipitation can be explained by the same mode of SSTs. The upward trend of springtime precipitation over southeastern China and downward trend of summertime precipitation over northern China are attributable to the warming trend of the ENSO-like mode. The recent frequent

summertime floods over central eastern China are linked to the warming trend of SSTs over the warm pool and Indian Ocean. Author

Annual Variations; China; Sea Surface Temperature; Summer; Spring (Season); Precipitation (Meteorology)

20040110319 NASA Langley Research Center, Hampton, VA, USA

Evaluation of Clouds and the Earth's Radiant Energy System (CERES) Scanner Pointing Accuracy using a Coastline Detection System

Currey, Chris; Smith, Lou; Neely, Bob; [1998]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Clouds and the Earth's Radiant Energy System (CERES) is a National Aeronautics and Space Administration (NASA) investigation to examine the role of clouds in the radiative energy flow through the Earth-atmosphere system. The first CERES scanning radiometer was launched on November 27, 1997 into a 35 inclination, 350 km altitude orbit, on the Tropical Rainfall Measuring Mission (TRMM) spacecraft. The CERES instrument consists of a three channel scanning broadband radiometer. The spectral bands measure shortwave (0.3 - 5 microns), window (8 - 12 microns), and total (0.3 - 100 microns) radiation reflected or emitted from the Earth-atmosphere system. Each Earth viewing measurement is geolocated to the Earth fixed coordinate system using satellite ephemeris, Earth rotation and geoid, and instrument pointing data. The interactive CERES coastline detection system is used to assess the accuracy of the CERES geolocation process. By analyzing radiative flux gradients at the boundaries of ocean and land masses, the accuracy of the scanner measurement locations may be derived for the CERES/TRMM instrument/satellite system. The resulting CERES measurement location errors are within 10% of the nadir footprint size. Precise pointing knowledge of the Visible and Infrared Scanner (VIRS) is required for convolution of cloud properties onto the CERES footprint; initial VIRS coastline results are included.

Author

Cloud Physics; Air Land Interactions; Radiant Flux Density; Earth Rotation; Geoids

20040110320 NASA Langley Research Center, Hampton, VA, USA

Project S'COOL

Green, Carolyn J.; Chambers, Lin H.; [1998]; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Students Clouds Observations On-Line or S'COOL project was piloted in 1997. It was created with the idea of using students to serve as one component of the validation for the Clouds and the Earth's Radiant Energy System (CERES) instrument which was launched with the Tropical Rainfall Measuring Mission (TRMM) in November, 1997. As part of NASA's Earth Science Enterprise CERES is interested in the role clouds play in regulating our climate. Over thirty schools became involved in the initial thrust of the project. The CERES instrument detects the location of clouds and identifies their physical properties. S'COOL students coordinate their ground truth observations with the exact overpass of the satellite at their location. Their findings regarding cloud type, height, fraction and opacity as well as surface conditions are then reported to the NASA Langley Distributed Active Archive Center (DAAC). The data is then accessible to both the CERES team for validation and to schools for educational application via the Internet. By March of 1998 ninety-three schools, in nine countries had enrolled in the S'COOL project. Joining the USA participants were from schools in Australia, Canada, France, Germany, Norway, Spain, Sweden, and Switzerland. The project is gradually becoming the global project envisioned by the project s creators. As students obtain the requested data useful for the scientists, it was hoped that students with guidance from their instructors would have opportunity and motivation to learn more about clouds and atmospheric science as well.

Author

Clouds (Meteorology); Atmospheric Physics; Meteorology; Radiant Flux Density

20040110334 NASA Langley Research Center, Hampton, VA, USA

Cloud Forcing and the Earth's Radiation Budget: New Ideas and New Observations

Barkstrom, Bruce R.; [1997]; 2 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

1. NEW PERSPECTIVES ON CLOUD-RADIATIVE FORCING. When the Earth Radiation Budget Experiment (ERBE) produced the first measurements of cloud-radiative forcing, the climate community interpreted the results from a context in which the atmosphere was a single column, strongly coupled to the Earth's surface. 2. NEW PERSPECTIVES ON CLOUD-RADIATION OBSERVATIONS. The climate community is also on the verge of adding a new dimension to its observational capability. In classic thinking about atmospheric circulation and climate, surface pressure was a readily available quantity. As meteorology developed, it was possible to develop quantitative predictions of future weather by bringing together a network of surface pressure observations and then of profiles of temperature and humidity obtained from balloons. 3. ON COMBINING OBSERVATIONS and THE - ORY. With this new capability, it is natural to seek recognizable features in the

observations we make of the Earth. There are techniques we can use to group the remotely sensed data in the individual footprints into objects that we can track. We will present one such image-processing application to radiation budget data, showing how we can interpret the radiation budget data in terms of cloud systems that are organized into systematic patterns of behavior - an ecosystem-like view of cloud behavior.
Derived from text
Cloud Physics; Atmospheric Radiation; Earth Radiation Budget Experiment; Energy Budgets

20040110374 NASA Langley Research Center, Hampton, VA, USA
Seasonal and Vegetational Variation in Albedo Measured During CERES Ground-Validation Pilot Study
Schuster, G. L.; Whitlock, C. H.; Plant, J. V.; Wheeler, R. J.; Moats, C. D.; Larman, K. T.; Ayers, J. K.; Feldl, E. K.; Proceedings of the 9th AMS Conference on Atmospheric Radiation; [1997], pp. 456; In English; Proceedings of the 9th AMS Conference on Atmospheric Radiation, 2-7 Feb. 1997, Long Beach, CA, USA; Copyright; Avail: CASI; A01, Hardcopy

The Clouds and the Earth's Radiant Energy System (CERES) satellite is scheduled for launch in the Fall of 1997 aboard the Tropical Rainfall Measuring Mission (TRMM). A surface measurement pilot study has been initiated in a 37-km region near Richmond, VA, for comparison with the CERES surface flux retrievals. Two-minute averaged upwelling and downwelling surface fluxes over a mostly deciduous forest have been recorded daily for the past two years, and show a broadband, shortwave daily albedo increase during the summer months. Evidence is presented that indicates vegetational changes in the forest as the overriding mechanism for this change. Upwelling flux measured over the entire region by helicopter-mounted instrumentation has been processed for four solar seasons. Future plans include the installation of four more albedo surface sites over various types of vegetation throughout the region.
Author
Annual Variations; Vegetation; Albedo

20040110381 NASA Langley Research Center, Hampton, VA, USA
Tornadic Vortex Signature (TVS) Produced by Constrained Pulsing Inertial Oscillation (PIO) Model
Costen, R. C.; [1997]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The TVS on Doppler radar indicates a midtropospheric vortex of Rossby number Ro 1000 that develops in a supercell storm shortly before a tornado descends. This paper shows how the PIO model, which was first described at the 1991 AGU Spring Meeting, could produce a TVS.
Author
Oscillations; Tornadoes; Vortices; Mathematical Models; Inertia

20040110415 State Univ. of New York, Albany, NY, USA
Diagnostic Studies of Large-Scale Weather Systems in the GEOS General Circulation Model
Keyser, Daniel; [2004]; 3 pp.; In English
Contract(s)/Grant(s): NAG5-11235; No Copyright; Avail: CASI; A01, Hardcopy

During the period covered by this report, the PI has contributed in an advisory capacity to various aspects of the evaluation of the nature run, including the development of research plans, the derivation of diagnostic procedures, and the interpretation of the results of the evaluation. Computing and data analysis have been performed by Dr. Jusem in consultation with Dr. Atlas. The PI's contribution to this effort has been rendered primarily by means of scheduled biweekly phone discussions with Dr. Jusem, supplemented by electronic mailings and postings on the Web.
Derived from text
Weather Forecasting; Large Scale Integration; Atmospheric General Circulation Models

20040110424 NASA Langley Research Center, Hampton, VA, USA
Feasibility Study For A Spaceborne Ozone/Aerosol Lidar System
Campbell, Richard E.; Browell, Edward V.; Ismail, Syed; Dudelzak, Alexander E.; Carswell, Allan I.; Ulitsky, Arkady; [1997]; 4 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

Because ozone provides a shield against harmful ultraviolet radiation, determines the temperature profile in the stratosphere, plays important roles in tropospheric chemistry and climate, and is a health risk near the surface, changes in natural ozone layers at different altitudes and their global impact are being intensively researched. Global ozone coverage is currently provided by passive optical and microwave satellite sensors that cannot deliver high spatial resolution measurements and have particular limitations in the troposphere. Vertical profiling DIfferential Absorption Lidars (DIAL) have shown

excellent range-resolved capabilities, but these systems have been large, inefficient, and have required continuous technical attention for long term operations. Recently, successful, autonomous DIAL measurements have been performed from a high-altitude aircraft (LASE - Lidar Atmospheric Sensing Experiment), and a space-qualified aerosol lidar system (LITE - Laser In-space Technology Experiment) has performed well on Shuttle. Based on the above successes, NASA and the Canadian Space Agency are jointly studying the feasibility of developing ORACLE (Ozone Research with Advanced Cooperative Lidar Experiments), an autonomously operated, compact DIAL instrument to be placed in orbit using a Pegasus class launch vehicle.
Author
Feasibility Analysis; Spaceborne Experiments; Aerosols; Ozone; Optical Radar; Temperature Profiles; Ultraviolet Radiation

20040110427 NASA Langley Research Center, Hampton, VA, USA
Independent Pixel and Two Dimensional Estimates of LANDSAT-Derived Cloud Field Albedo
Chambers, L. H.; Wielicki, Bruce A.; Evans, K. F.; [1996]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A theoretical study has been conducted on the effects of cloud horizontal inhomogeneity on cloud albedo bias. A two-dimensional (2D) version of the Spherical Harmonic Discrete Ordinate Method (SHDOM) is used to estimate the albedo bias of the plane parallel (PP-IPA) and independent pixel (IPA-2D) approximations for a wide range of 2D cloud fields obtained from LANDSAT. They include single layer trade cumulus, open and closed cell broken stratocumulus, and solid stratocumulus boundary layer cloud fields over ocean. Findings are presented on a variety of averaging scales and are summarized as a function of cloud fraction, mean cloud optical depth, cloud aspect ratio, standard deviation of optical depth, and the gamma function parameter Y (a measure of the width of the optical depth distribution). Biases are found to be small for small cloud fraction or mean optical depth, where the cloud fields under study behave linearly. They are large (up to 0.20 for PP-IPA bias, -0.12 for IPA-2D bias) for large v. On a scene average basis PP-IPA bias can reach 0.30, while IPA-2D bias reaches its largest magnitude at -0.07. Biases due to horizontal transport (IPA-2D) are much smaller than PP-IPA biases but account for 20% RMS of the bias overall. Limitations of this work include the particular cloud field set used, assumptions of conservative scattering, constant cloud droplet size, no gas absorption or surface reflectance, and restriction to 2D radiative transport. The LANDSAT data used may also be affected by radiative smoothing.
Author
Landsat Satellites; Cloud Cover; Albedo; Boundary Layers; Inhomogeneity; Surface Properties

20040110529 Utah Univ., Salt Lake City, UT
An Evaluation of High-Resolution Modeling and Statistical Forecast Techniques Over Complex Terrain
Hart, Kenneth A.; Aug. 2004; 118 pp.; In English
Report No.(s): AD-A425524; AFIT-CI-04-432; No Copyright; Avail: CASI; A06, Hardcopy

Local topographic effects and spatial land-surface variability present unique challenges for weather forecasting in areas of complex terrain. The primary goal of this research is to improve the accuracy of weather forecasts over the fine- scale topography of the Intermountain West using statistical and numerical modeling techniques. Specifically, we seek to determine where, when and why decreasing the horizontal grid spacing of numerical models improves forecast accuracy and to evaluate the added benefits of using statistical techniques to correct for systematic numerical model deficiencies.
DTIC
Forecasting; High Resolution; Statistical Analysis; Terrain

20040110600 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA
California Climiate Change, Hydrologic Response, and Flood Forecasting
Miller, N. L.; Nov. 2003; In English
Report No.(s): DE2004-820274; No Copyright; Avail: National Technical Information Service (NTIS)

There is strong evidence that the lower atmosphere has been warming at an unprecedented rate during the last 50 years, and it is expected to further increase at least for the next 100 years. Warmer air mass implies a higher capacity to hold water vapor and an increased likelihood of an acceleration of the global water cycle. This acceleration is not validated and considerable new research has gone into understanding aspects of the water cycle (e.g. Miller et al. 2003). Several significant findings on the hydrologic response to climate change can be reported. It is well understood that the observed and expected warming is related to sea level rise. In a recent seminar at Lawrence Berkeley National Laboratory, James Hansen (Director of the Institute for Space Studies, National Aeronautics and Space Administration) stressed that a 1.25 Wm(sup -2) increase in radiative forcing will lead to an increase in the near surface air temperature by 1 C. This small increase in temperature from

2000 levels is enough to cause very significant impacts to coasts. Maury Roos (Chief Hydrologist, California Department of Water Resources) has shown that a 0.3 m rise in sea level shifts the San Francisco Bay 100-year storm surge flood event to a 10-year event. Related coastal protection costs for California based on sea level rise are shown. In addition to rising sea level, snowmelt-related streamflow represents a particular problem in California. Model studies have indicated that there will be approximately a 50% decrease in snow pack by 2100. This potential deficit must be fully recognized and plans need to be put in place well in advance. In addition, the warmer atmosphere can hold more water vapor and result in more intense warm winter-time precipitation events that result in flooding. Understanding the mechanisms of large-scale atmospheric dynamics and its local impacts remain topics of intensive research. The ability to predict extreme events and provide policy makers with this information, along with climate change and hydrologic response information, will help to guide planning to form a more resilient infrastructure in the future.
NTIS
Climate Change; Hydrology; Floods; Forecasting

20040110705 US Arctic Research Commission, Arlington, VA, USA
Report on Goals and Objectives for Arctic Research
2003; 54 pp.; In English
Report No.(s): PB2004-107241; No Copyright; Avail: CASI; A04, Hardcopy

The Arctic Research and Policy Act of 1984 (as amended) directs the USA Arctic Research Commission to publish its Report on Goals and Objectives for Arctic Research every two years to guide the Interagency Arctic Research Policy Committee, and thus, the member Federal Agencies as they prepare their revision of the National Arctic Research Plan. This report for the year 2003 reflects the best judgement of the Commission based upon information gathered at our formal meetings, from other Arctic research community meetings, the Commission's Group of Advisors, through reading and from our daily interactions with those involved in Arctic research - US and foreign researchers, researches administrators, Alaskan natives and others living and working in the North. The Commission has studied the research programs of both the USA and other nations with Arctic interests. We have attempted to synthesize them into a focused set of goals that meet what we understand are federal, state, local and native needs. At the same time we have tried to be sensitive to the dynamics of the Arctic which are affecting the international as well as the national landscape of politics, economics, sociology, security and the environment.
NTIS
Arctic Regions; Research Projects

20040110737 National Center for Atmospheric Research, Boulder, CO, USA
Sea Ice Simulation of the Community Climate System Model, Version Two
Briegleb, B. P.; Hunke, E. C.; Bitz, C. M.; Schramm, J. L.; Moritz, R. E.; Jan. 2004; 38 pp.; In English
Report No.(s): PB2004-105849; NCAR/TN-455-STR; No Copyright; Avail: CASI; A03, Hardcopy

The Community Climate System Model (CCSM) is a coupled climate model consisting of atmosphere, ocean, land, and sea ice components. The model includes a coupler which passes fluxes and state variables from one model component to another. The model has been designed to support experiments that contribute to the understanding of past, present and future climates.
NTIS
Sea Ice; Climate Models

20040110746 North Dakota Univ., Grand Forks, ND, USA
Airborne In Situ and Ground-based Polarimetric Radar Measurements of Tropical Convection in Support of CRYSTAL-FACE
Poellot, Michael R.; Kucera, Paul A.; September 08, 2004; 28 pp.; In English
Contract(s)/Grant(s): NAG5-11509; No Copyright; Avail: CASI; A03, Hardcopy

This report describes the work performed by the University of North Dakota (UND) under NASA Grant NAG5-11509, titled Airborne In Situ and Ground-based Polarimetric Radar Measurements of Tropical Convection in Support of CRYSTAL-FACE. This work focused on the collection of data by two key platforms: the UND Citation II research aircraft and the NASA NPOL radar system. The CRYSTAL-FACE (C-F) mission addresses several key issues from the NASA Earth System Enterprise, including the variability of water in the atmosphere, the forcing provided by tropical cirrus and the response of the Earth system to this forcing. In situ measurements and radar observations of tropical convection, cirrus clouds

and their environment are core elements of C-F. One of the primary issues that C-F is addressing is the relationship of tropical cirrus anvils to precipitating deep convection. The in situ measurements from C-F are being used to validate remote sensing of Earth-Atmosphere properties, increase our knowledge of upper tropospheric water vapor and its distribution, and increase our knowledge of tropical cirrus cloud morphology and composition. Radar measurements, especially polarimetric diversity observations available fiom the NASA NPOL radar, are providing essential information about the initiation, modulation, and dissipation of convective cores and the generation of associated anvils in tropical convection. Specifically, NPOL radar measurements contain information about convective intensity and its vertical structure for comparison with thermodynamic and kinematic environmental measurements observed from soundings. Because of the polarimetric diversity of MOL, statistics on bulk microphysical properties can be retrieved and compared to the other characteristics of convection and associated cirrus anvils. In summary, the central objectives of this proposal were to deploy the UND Citation research aircraft as an in situ sensing platform for this mission and to provide collaborative analyses of the recorded data and to deploy the NPOL radar to observe the characteristics of cirrus and parent convection.
Author (revised)
Tropical Meteorology; Convection; In Situ Measurement; Radar Measurement; Polarimetry

20040110775 National Center for Atmospheric Research, Boulder, CO, USA
Chemical Ionization Mass Spectrometry-Based Measurements of HO2 and RO2 During TRACE-P
Cantrell, Christopher A.; Eisele, Fred L.; [2004]; 4 pp.; In English
Contract(s)/Grant(s): NCC1-424; No Copyright; Avail: CASI; A01, Hardcopy

The Transport and Chemical Evolution over the Pacific (TRACE-P) mission extends NASA's Global Tropospheric Experiment (GTE) series of campaigns. TRACE-P was an aircraft-based campaign that was part of a larger ground-based and aircraft-based program (APARE) under the auspices of the International Global Atmospheric Chemistry (IGAC) program. TRACE-P was designed to (1) determine the chemical composition of Asian outflow over the western Pacific, and to (2) determine the chemical evolution of the Asian outflow. These objectives were addressed through a variety of observations and numerical modeling exercises. In particular, the goals included sampling strategies that would improve understanding of the budgets of odd hydrogen species (OH and HO2), budgets of NOx (NO, NO2, and their reservoirs), and impacts of oxidants produced in the outflow on air quality in the USA. The NASA DC-8 and P-3B aircraft were deployed in the March and April, 2001 out of primary bases of operation in Hong Kong and Yokota Air Base in Japan. These two aircraft have complementary capabilities which allow high altitude and long range impacts, as well as low altitude, local impacts to be assessed. In order to quantify the composition and evolution of Asian outflow, it is important to quantify as many species as possible including photochemically active species (e.g. NO2, CH2O, O3, acetone, etc.), sources species (VOCs, CO, NOx, SO2, aerosols), reactive intermediates including free radicals (OH, HO2, RO2, and their reservoirs), and end products (nitric acid, sulfuric acid, secondary aerosols, etc.). The more complete the measurement suite, the more tightly constrained the numerical modeling can be (within the uncertainties of the measurements). The numerical models range in sophistication from simple steady state box models (as employed in this study) to multi-dimensional chemical transport models. Data were collected on approximately 20 flights of the DC-8 and 21 flights of the P-3B. Observations from both aircraft were used in the present analysis, but primarily focused on the P-3B flights since that was the platform on which the peroxy radical instrumentation was based.
Author
Atmospheric Chemistry; Mass Spectroscopy; Atmospheric Composition; Air Sampling

20040110878 NASA Marshall Space Flight Center, Huntsville, AL, USA
Effects of Uncertainty in TRMM Precipitation Radar Path Integrated Attenuation on Interannual Variations of Tropical Oceanic Rainfall
Robertson, Franklin R.; Fitzjarrald, Dan E.; Kummerow, Christian D.; Geophysical Research Letters; 2003; ISSN 0094-8276; Volume 30, No. 4, pp. 29-1 - 29-4; In English; Copyright; Avail: Other Sources

Considerable uncertainty surrounds the issue of whether precipitation over the tropical oceans (30 deg N/S) systematically changes with interannual sea-surface temperature (SST) anomalies that accompany El Nino (warm) and La Nina (cold) events. Time series of rainfall estimates from the Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (PR) over the tropical oceans show marked differences with estimates from two TRMM Microwave Imager (TMI) passive microwave algorithms. We show that path-integrated attenuation derived from the effects of precipitation on the radar return from the ocean surface exhibits interannual variability that agrees closely with the TMI time series. Our analysis of discrepancies between the PR rainfall and attenuation suggests that uncertainty in the assumed drop size distribution and associated

attenuation/reflectivity/rainfall relationships inherent in single-frequency radar methods is a serious issue for studies of interannual variability.
Author
Trmm Satellite; Meteorological Radar; Rain; Tropical Meteorology; Marine Meteorology

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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*.

20040110230 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Response of the North Atlantic Bloom to NAO Forcing
Mizoguchi, Ken-Ichi; Worthen, Denise L.; Hakkinen, Sirpa; Gregg, Watson W.; May 20, 2004; 33 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Results from the climatologically forced coupled ice/ocean/biogeochemical model that covers the Arctic and North Atlantic Oceans are presented and compared to the chlorophyll fields of satellite-derived ocean color measurements. Biogeochemical processes in the model are determined from the interactions among four phytoplankton functional groups (diatoms, chlorophytes, cyanobacteria and coccolithophores) and four nutrients (nitrate, ammonium, silicate and dissolved iron). The model simulates the general large-scale pattern in April, May and June, when compared to both satellite-derived and in situ observations. The subpolar North Atlantic was cool in the 1980s and warm in the latter 1990s, corresponding to the CZCS and SeaWiFS satellite observing periods, respectively. The oceanographic conditions during these periods resemble the typical subpolar upper ocean response to the NAO+ and NAO-phases, respectively. Thus, we use the atmospheric forcing composites from the two NAO phases to simulate the variability of the mid-ocean bloom during the satellite observing periods. The model results show that when the subpolar North Atlantic is cool, the NAO+ case, more nutrients are available in early spring than when the North Atlantic is warm, the NAO-case. However, the NAO+ simulation produces a later bloom than the NAO-simulation. This difference in the bloom times is also identified in SeaWiFS and CZCS satellite measurements. In the model results, we can trace the difference to the early diatom bloom due to a warmer upper ocean. The higher nutrient abundance in the NAO+ case did not provide larger total production than in the NAO- case, instead the two cases had a comparable area averaged amplitude. This leads us to conclude that in the subpolar North Atlantic, the timing of the spring phytoplankton bloom depends on surface temperature and the magnitude of the bloom is not significantly impacted by the nutrient abundance.
Author
Oscillations; Atlantic Ocean; Biogeochemistry; Ocean Models

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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*.

20040110257 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Foliar Reflectance and Fluorescence Responses for Corn and Soybean Plants Under Nitrogen Stress
Middleton, E. M.; Campbell, P. K. Entcheva; Corp, L. A.; Butcher, L. M.; McMurtrey, J. E.; [2003]; 1 pp.; In English; Ecological Society of America Annual Meeting, 2-8 Aug. 2003, Savannah, GA, USA; No Copyright; Avail: Other Sources; Abstract Only

We are investigating the use of spectral indices derived from actively induced fluorescence spectra and passive optical spectra. We examined the influence of photosynthetic pigment, carbon (C) and nitrogen (N) content on the spectral fluorescence and passive optical property characteristics of mature, upper leaves from plants provided different N fertilizer application rates: 20%, 50%, 100% and 150% of recommended N levels. A suite of optical, fluorescence, and biophysical measurements were collected on leaves from field grown corn (Zea mays L.) and soybean plants (Glycine max L.) grown in pots (greenhouse + ambient sunlight. Steady state laser-induced fluorescence emission spectra (5 nm resolution) were obtained from adaxial and abaxial surfaces resulting from excitation at single wavelengths (280, 380 or 360, and 532 nm). For emission spectra produced by each of these excitation wavelengths, ratios of emission peaks were calculated, including the red far-red

chlorophyll fluorescence (ChlF) ratio (F685/F740) and the far-red/green (F740/F525) ratio. High resolution (\h 3 nm) optical spectra (350-2500 nm) of reflectance, transmittance, and absorptance were also acquired for both adaxial and abaxial leaf surfaces. Species differences were demonstrated for several optical parameters. A 'red edge' derivative ratio determined from transmittance spectra [as the maximum first deivative, between 650-750 nm, normalized to the value at 744 nm, or Dmax/D744], was strongly associated with the C/N ratio (r(exp 2) = 0.90, P +/- 0.001). This ratio, calculated from reflectance spectra, was inversely related to chlorophyll b content (r(exp 2) = 0.91, P +/- 0.001) as was the ChlF (F685/F740) ratio obtained with 532 nm excitation (r(exp 2) = 0.76, P +/- 0.01). Discrimination of N treatment groups was possible with specific fluorescence band ratios (e.g., F740/F525 obtained with 380 nm excitation). Higher ChlF and blue-green emissions were measured from the abaxial leaf surfaces. Abaxial surfaces also produced higher reflectances, in general, in the 400-800 nm spectrum.
Author
Foliage; Reflectance; Fluorescence; Corn; Soybeans

20040110469 Massachusetts Inst. of Tech., Cambridge, MA
Zebrafish Cardiovascular cDNA Microarrays: Expression Profiling and Gene Discovery in Embryos Exposed to 2,3,7,8-Tetrachlorodibenzo-P-Dioxin
Handley, Heather M.; Sep. 2003; 292 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425266; MIT/WHOI-2003-19; No Copyright; Avail: CASI; A13, Hardcopy

2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is a potent teratogen that impacts the developing cardiovascular system. Hallmarks of embryonic exposure include cardiac malformation, impaired circulation, loss of erythrocytes, pericardial and yolk sac edema, and early life stage mortality. However, the mechanism of TCDD cardiovascular embryotoxicity is poorly understood. The primary goal of this thesis was to identify TCDD-responsive genes likely to be involved in processes of toxicity. We constructed microarrays using cDNA libraries derived from zebrafish embryonic and adult heart tissue. Embryonic heart arrays were used for protocol development. The resulting workflow was employed in the production of adult heart microarrays containing -2800 unique cardiovascular genes. These arrays were used to establish gene expression profiles of zebrafish embryos exposed to 1.84+/-0. 42 or 1O.74+/-0.1.38 ng TCDD/g embryo. Alterations in cardiovascular gene expression were limited; 44 genes or ESTs were significantly differentially expressed \g1.8-fold (p- values \h5x10(sub -4)), and only CYPlA and CYP1B1 were induced \g4- fold. Transcriptional responses to TCDD were highly dose- dependent, and adaptive responses were a prevalent feature of TCDD-modulated gene expression. Microarray analyses indicated induction of genes in three major functional classes xenobiotic detoxification, sarcomere structure, and energy transfer. TCDD-modulation of selected genes was verified by RT- PCR. Induction of mitochondrial electron transfer genes was variable and modest; such induction provides a possible pathway to reactive oxygen generation and cardiac pathology. Sarcomere genes were generally robustly induced, but RT-PCR indicated suppression of cardiac troponin T2. The current data suggest that TCDD causes cardiomyopathy in zebrafish embryos.
DTIC
Cardiovascular System; Deoxyribonucleic Acid; Edema; Embryos; Erythrocytes; Heart Diseases; Toxicity; Transcription (Genetics)

20040110473 Woods Hole Oceanographic Inst., MA
Cytochrome P450 1A1 and Aromatase (CYP19) in Cetaceans: Enzyme Expression and Relationship to Contaminant Exposure
Wilson, Joanna Y.; Sep. 2003; 264 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): WHOI-SEA GRANT R/B-162; NIH SUPERFUND P-42-ES07381
Report No.(s): AD-A425276; MIT/WHOI-2003-20; No Copyright; Avail: CASI; A12, Hardcopy

Contaminant exposure has been associated with toxicity in cetaceans. Early biochemical responses prior to, but associated with, contaminant-induced toxicity will aid in understanding the susceptibility of cetaceans to contaminants. Cytochrome P45O lAl (CYPlAl) induction by certain polychiorinated biphenyls (PCBs) has been correlated with toxicity in rodents. CYPlAl expression was measured in organs from beluga whales and white-sided dolphins and integument biopsies from bottlenose dolphins. Age and sex do not influence CYPlAl expression in these species. Mono-ortho PCB concentrations were correlated with CYP lAl in bottlenose and white-sided dolphin. White-sided dolphins have higher PCB concentrations hut lower hepatic CYPIAl expression than beluga. Beluga thus appear sensitive to CYPlAl induction by PCBs. These studies demonstrate that comparative studies between cetacean species could determine the relative susceptibility of cetaceans. Aromatase is responsible for estrogen production and studies suggest that PCBs may alter its activity. The sequence and catalytic properties of a cetacean aromatase were similar to other mammalian aromatases. Evolutionary analyses of vertebrate

aromatases revealed striking functional conservation. These data show that aromatase studies in other mammals are applicable to cetacean species. Experimental work in model organisms, coupled with studies in cetaceans, could infer the physiological role and transcriptional control of cetacean aromatase.
DTIC
Contaminants; Cytochromes; Dolphins; Enzymes; Exposure; Toxicity; Whales

20040110489 Industrial Coll. of the Armed Forces, Washington, DC
Healthcare Industry Study
Ba Omar, Alawi; Brown, Thomas; Campagnone, Mari-Josette; Chasteen, Gregory; Dee, Thomas; Jan. 2003; 29 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425311; No Copyright; Avail: CASI; A03, Hardcopy

Our nation's healthcare system affects not only the well being of our citizens, but the strength of our society as a whole. Healthcare is a critical pillar of the national security framework that affects not only individual health, but also economic efficiency and public confidence. This industry is both complex and fragmented, consisting not only of consumers and producers/ providers, but also of a multitude of third party payers that distort the economic efficiency of the market system. The U.S. spends $1.4 trillion annually on healthcare, higher than any other nation, and representing over 14% of Gross Domestic Product (GDP). This paper accesses the utility of this unequalled level of expenditure through measures of access, cost and quality. While the quality of the U.S. healthcare system is unparalleled in the areas of acute intervention, pharmaceuticals, medical education, and research and development, the provision of routine preventative care is less than optimal. When combined with the inability of a large percentage of the population to access these routine services, we conclude that the demonstrated outcomes of the U.S. healthcare system do not reflect the high cost. Improvements are necessary to provide more equitable access and to attain business efficiencies that will help control costs. These efficiencies can be gained through better industry standardization; especially in licensing and administration. Such efficiencies will require an enhanced government role independent of shortterm parochialism. The Government can lead the way to improved efficiency and equity in the thriving healthcare market as it encourages the individual lifestyle changes necessary to reverse the alarming and costly trend towards unhealthy personal choices such as poor diets and habits, sedentary levels of physical activity, and high-risk activities.
DTIC
Economics; Industries; Management Systems; Medical Services; Security

20040110502 Scripps Institution of Oceanography, La Jolla, CA
Workshop on Imaging of Complex Media with Acoustic and Elastic Waves
Kuperman, W.; Sep. 1999; 51 pp.; In English
Contract(s)/Grant(s): N00014-99-1-0220
Report No.(s): AD-A425356; No Copyright; Avail: CASI; A04, Hardcopy

A workshop was held to introduce new developments in acoustics and signal processing in the field of ocean acoustics and tomography, laboratory ultrasonics, seismology and medical ultrasonics. The underlying theme is time reversal acoustics.
DTIC
Elastic Waves; Imaging Techniques; Sound Waves; Tomography; Underwater Acoustics

20040110508 Rockefeller Univ., New York, NY
Using Phage Lytic Enzymes to Kill Pathogenic Bacteria
Fischetti, Vincent A.; Aug. 2, 2004; 3 pp.; In English
Contract(s)/Grant(s): DAAD19-01-1-0318
Report No.(s): AD-A425375; ARO-42293.1-LS; No Copyright; Avail: CASI; A01, Hardcopy

Bacteriophage lytic enzymes are highly evolved molecules used by the phage to quickly destroy the bacterial cell wall to release bacteriophage progeny. The investigators have exploited the rapid and lethal action of these enzymes to destroy pathogenic bacteria. These enzymes are specific for the species or strain from which they were produced, thus avoiding destruction of the surrounding normal commensal organisms found on mucosal surfaces. They now have enzymes that are specific for S. pyogenes, S. pneumoniae, and B. anthracis with enzyme for S. aureus, E. faecalis/E. faecium, and group B streptococci in progress. Their results using any of the phage lytic enzymes show that in vitro, 10(exp 7) bacteria can be sterilized seconds after enzyme contact. In animal model experiments, they were able to colonize mice with either streptococcal or pneumococcal species (orally or nasally) and remove them completely with phage enzymes delivered to these

sites. In a septicemia model using S. pneumoniae, bacteria are reduced by \g2-logs from the blood of infected animals with a single intravenous dose of enzyme. In subsequent experiments, they plan to use constant infusion to clear organisms from the blood. Thus, phage lytic enzymes are a new reagent that may be used to control pathogenic bacteria. A list of 7 publications is included.
DTIC
Bacillus; Bacteria; Bacteriophages; Enzymes; Pathogens; Pneumonia; Staphylococcus; Streptococcus

20040110517 Operational Technologies Corp., Beavercreek, OH
Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) Field Demonstration Report: Air Force Plant Number 6 Fuel Farm Dobbins AFB, Georgia
Reed, Dennis A.; Sterner, Teresa R.; May 2002; 84 pp.; In English
Contract(s)/Grant(s): F33601-01-F-9064; Proj-1710
Report No.(s): AD-A425422; AFRL-HE-WP-TR-2002-0158; No Copyright; Avail: CASI; A05, Hardcopy

A demonstration of the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) approach for assessing human health risk at weathered petroleum release sites was performed at a former above ground storage fuel farm (FF) located at Dobbins Air Force Base, Marietta, Georgia. The fuel farm was used to store and dispense jet petroleum (JP) fuel, blend numbers 4, 5 and S (i.e., JP-4, JP-5 and JP-8) over a period of approximately 40 years, from the mid l950s through the early 1990s. Use of the FF was discontinued in 1993. A preliminary site characterization survey performed in 1997 detected total petroleum hydrocarbon (TPH) at concentrations ranging from 517 mg/kg to 2,239 mg/kg in four of eight grab samples of soil. A total of 15 primary soil samples were collected at depths ranging from 1.0 to 8.5 feet belowground surface to support the TPHCWG demonstration. Grab samples collected in Encore samplers from the sampling interval were analyzed by International Technology (IT) Corp. (EMAX Lab, Inc.) for TPH gasoline range orgaincs (GRO) and benzene, toluene, ethylbenzene and xylenes (BTEX). Soil composited from the sampling interval was split and subsequently analyzed by EMAX Lab for TPH diesel range organincs (DRO) and polycyclic aromatic hydrocarbons (PAHs) and by Operational Technologies (OpTech) Corp (Lancaster Laboratories) for aliphatic and aromatic hydrocarbons fractions.
DTIC
Crude Oil; Hydrocarbons; Petroleum Products; Trichloroethylene

20040110526 Department of Energy, Washington, DC
DNA Barcodes and Watermarks
Block, Steven M.; Jun. 2004; 60 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425496; JSR-03-305; No Copyright; Avail: CASI; A04, Hardcopy

This study was conducted on behalf of the DOE during the summer of 2003. The JASON Study explored the feasibility of a program to tag genetically the microorganisms used for bioremediation, for the purpose of identification.
DTIC
Biodegradation; Deoxyribonucleic Acid

20040110530 Wright State Univ., Dayton, OH
Exploration of - 'Nurses's Use of Nonpharmacological Interventions for Pain Management of Hospitalized Oncology Patients
Skupski, Vickie L.; Jan. 2004; 79 pp.; In English
Report No.(s): AD-A425525; AFIT-CI-04-510; No Copyright; Avail: CASI; A05, Hardcopy

The purpose of this study was to explore nurses' use of nonpharmacological interventions in pain management for hospitalized oncology patients through the following questions. What types of nonpharmacological interventions, were nurses using in the pain management of hospitalized oncology patients? Was there a difference in the patient's numerical rating scale (NRS) score before and after nonpharmacological interventions? Was there a patient gender difference in the frequency and type of nonpharmacological interventions in hospitalized oncology patients?
DTIC
Medical Services; Pain; Patients

20040110992 California Univ., San Diego, La Jolla, CA, USA, Salk Inst. for Biological Studies, San Diego, CA, USA, Scripps Research Inst., La Jolla, CA, USA
The Chemistry of Early Self-Replicating Systems
Bada, Jeffrey L.; August 25, 2004; 5 pp.; In English
Contract(s)/Grant(s): NAG5-13621; No Copyright; Avail: CASI; A01, Hardcopy

On June 10, 2003, a symposium 'Celebrating 50 Years of Prebiotic Chemistry' honoring the 50th Anniversary of the 1953 publication of the Miller Experiment in SCIENCE was held at the University of California, San Diego. This event was organized and hosted by the NASA Specialized Center of Research and Training in Exobiology. It was sponsored by NASA, the Dean of Physical Sciences and the Department of Chemistry and Biochemistry at the University of California, San Diego (UCSD). The following events were held: 1) For the symposium, public lectures and a reception were held at UCSD on June 10, 2003 in honor of the 50th Anniversary of the Miller Experiment. The speakers were the NSCORT/Exobiology Principal Investigators Dr. Jeffrey L. Bada and Dr. Gerald F. Joyce and the moderator, Dr. Leslie Orgel; 2) A evening discussion seminar and dinner was held at UCSD with invited scientists, NSCORT investigators, NASA Headquarters Officials and the Chancellor and Officials of the University of California, San Diego. Stanley Miller has had a long history of support from the NASA Exobiology Section. This event commemorated the anniversary of his classic experiment and was a small recognition of his contributions to the field.
Author (revised)
Lectures; Biochemistry; Paleobiology

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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*.

20040095883 Army Research Inst. of Environmental Medicine, Natick, MA
The Impact of Caffeine on Cognitive and Physical Performance and Marksmanship During Sustained Operations
McLellan, Tom M.; Bell, Doug G.; Lieberman, Harris R.; Kamimori, Gary H.; Jan. 2004; 9 pp.; In English; Original contains color illustrations
Report No.(s): AD-A424932; No Copyright; Avail: CASI; A02, Hardcopy

Recent military operations have shown the importance of sustaining operational capabilities throughout the day and night for prolonged periods of time. Such a requirement inevitably leads to various states of sleep deprivation in very stressful environments. It is well documented that sleep loss impairs cognitive performance, and both physical and cognitive performance alone or in combination are critical for the successful outcome across the full spectrum of military operations. Cognitive performance will be degraded with less than 7 hours of sleep in each 24 hours. If 4 to 7 hours of sleep are obtained within every 24- hour period, cognitive performance will stabilize at a lower level, with less than 4 hours of sleep in every 24 hours, cognitive performance will degrade continuously and rapidly over days with stabilization. Physical performance is more resistant to sleep deprivation, but nonetheless those physical tasks that involve self-pacing and motivational efforts to continue are affected by sleep deprivation. Military guided have been developed to assist commanders in the management of cognitive fatigue during periods of sleep deprivation, but these guides have not considered in detail the impact of intervention strategies that could be used to optimize both cognitive and physical performance.
DTIC
Caffeine; Cognition; Human Performance; Mental Performance; Sleep Deprivation; Stress (Psychology)

20040100724 NASA Langley Research Center, Hampton, VA, USA
Biological Response to SPE Exposures
Wilson, J. W.; Cucinotta, F. A.; Kim, M.; Shinn, J. L.; Jones, T. D.; Chang, C. K.; [2004]; 15 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

It has long been recognized that a single solar particle event (SPE) can produce, over a short period of time, exposures on the order of LD50 for humans under normal physiological conditions. It is further recognized that recovery from injury over the period of exposure would greatly increase the chances of survival (dose rate effects) although such effects were left unquantified. In the present report we use the bioresponse model derived from a broad range of animal and human exposure data for evaluation of troop readiness in tactical nuclear warfare to evaluate the biological risk posed by the solar event of 4 August 1972. The astronaut blood forming organ (BFO) exposure in deep space would have been 2.2 Sv (1.6 Gy) in a space suit, 1.8 Sv (1.3 Gy) in an aluminum pressure vessel, and 0.7 Sv (0.5 Gy) in an equipment room compared to an X-ray mortality threshold of 1.5 Gy (assuming high dose rate). We find BFO dose rate effectiveness factors for this SPE on the order of 3 to 4, greatly reducing the mortality risks for this event. There is an approximate 3 percent chance that an even larger event may occur for which exposures could be 2-4 times higher. Assured survival of the astronaut requires added shelter shielding

and a warning system for this event. The required mass of the shelter shield can be greatly reduced by using hydrogenous materials such as polymers, water, food, and other biological materials in its construction. Limitations of the current bioresponse model arise from the exposures taking place in the microgravity environment wherein the immune system is already challenged and the effective mortality threshold may be reduced by a factor of two. Such microgravity effects could greatly affect astronaut risks.
Author
Solar Corpuscular Radiation; Physiological Responses; Biological Effects; Radiation Dosage

20040110269 NASA Langley Research Center, Hampton, VA, USA
Cosmic Ray Hits in the Central Nervous System at Solar Maximum
Curtis, S. B.; Vazquez, M. E.; Wilson, J. W.; Kim, M.-H. Y.; [1997]; 6 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

It has been suggested that a manned mission to Mars be launched at solar maximum rather than at solar minimum to minimize the radiation exposure to galactic cosmic rays. It is true that the number of hits from highly ionizing particles to critical regions in the brain will be less at solar maximum, and it is of some interest to estimate how much less. We present here calculations for several sites within the brain from iron ions (z = 26) and from particles with charge, z, greater than or equal to 15. The same shielding configurations and sites in the brain used in an earlier paper for solar minimum are employed so that direct comparison of results between the two solar activity conditions can be made. A simple pressure-vessel wall and an equipment room onboard a spacecraft are chosen as shielding examples. In the equipment room, typical results for the thalamus (100 mm2 area) are that the probability of any given cell nucleus being hit decreases from 10 percent at solar minimum to 6 percent at solar maximum for particles with z greater than or equal to 15 and from 2.3 percent to 1.3 percent for iron ions. We conclude that this modest decrease in hit frequency (less than a factor of two) is not a compelling reason to avoid solar minimum for a manned mission to Mars.
Author
Manned Mars Missions; Galactic Cosmic Rays; Thalamus; Solar Activity; Central Nervous System; Iron; Retina

20040110512 Naval Health Research Center, Brooks AFB, TX
Disruption of Visual Flight Control in a Synthetic Cockpit, Resulting from Continuous vs. Discontinuous Laser Glare
Beer, Jeremy; May 4, 2004; 35 pp.; In English
Report No.(s): AD-A425386; No Copyright; Avail: CASI; A03, Hardcopy

An experimental study was performed in a simulator to measure visual disruption resulting from exposure to discontinuous (strobing) laser glare in a flight control task, and compare this to the disruption from continuous laser glare. Seven pilots performed a nighttime visual approach task across repeated experimental sessions. Flights were assigned to conditions including no-glare (baseline), continuous glare, and strobing glare. The strobing conditions included two additional nested manipulations, whereby the duty cycle and pulse repetition frequency were varied. Flight control was assessed quantitatively using the RMS of the deviation from an ideal linear flight path, and the standard deviation of aircraft heading. Both metrics identified disruption in the flights that included laser stimuli. Disruption was greater in the continuous glare condition than in strobing conditions, except for the strobing condition that combined the most rapid pulse repetition frequency with a higher duty cycle. In some flights in this last condition, deterioration in flight control was greater than in the continuous glare condition. Within strobing conditions, both pulse frequency and duty cycle influenced control error. Findings suggest that strobing lasers with certain temporal profiles can not only obscure scene visibility (as continuous glare does) but also interfere with dynamic visual processing.
DTIC
Cockpits; Eye (Anatomy); Flight Control; Glare; Laser Damage; Lasers; Safety; Visual Flight

20040110724 Mount Sinai School of Medicine, New York, NY, USA
Nitric Oxide Signaling in Hypergravity-Induced Neuronal Plasticity
Holstein, Gay R.; [2003]; 3 pp.; In English
Contract(s)/Grant(s): NAG2-1191; No Copyright; Avail: CASI; A01, Hardcopy

The goal of this research project was to identify the neurons and circuits in the vestibular nuclei and nucleus prepositus hypoglossi that utilize nitric oxide (NO) for intercellular signaling during gravity-induced plasticity. This objective was pursued using histochemical and immunocytochemical approaches to localize NO-producing neurons and characterize the fine morphology of the cells in ground-based studies of normal rats, rats adapted to hypergravity, and rats adapted to hypergravity

and then re-adapted to the 1G environment. NO-producing neurons were identified and studied using four methodologies: i) immunocytochemistry employing polyclonal antibodies directed against neuronal nitric oxide synthase (nNOS), to provide an indication of the capacity of a cell for NO production; ii) immunocytochemistry employing a monoclonal antibody directed against L-citrulline, to provide an indirect index of the enzyme's activity; iii) histochemistry based on the NADPH-diaphorase reaction, for fuI1 cytological visualization of neurons; and iv) double immunofluorescence to co-localize nNOS and L-citrulline in individual vestibular nuclei (VN) and neurons.
Derived from text
High Gravity Environments; Neurophysiology; Nitric Oxide; Plastic Properties; Vestibules; Histochemical Analysis

20040110973 Civil Aerospace Medical Inst., Oklahoma City, OK, USA
Accurate Assignment of Ethanol Origin in Postmortem Urine: A Case Study
Johnson, Robert D.; Lewis, Russell J.; Canfield, Dennis V.; Dubowski, Kurt M.; Blank, C. LeRoy; August 2004; 12 pp.; In English
Contract(s)/Grant(s): AM-B-02-TOX-204
Report No.(s): DOT/FAA/AM-04/13; No Copyright; Avail: CASI; A03, Hardcopy

Specimens from fatal aviation accident victims are submitted to the FAA Civil Aerospace Medical Institute for toxicological analysis. During toxicological evaluations, ethanol analysis is performed on all cases. Care must be taken when interpreting a positive ethanol result due to the potential for postmortem ethanol formation. Several indicators of postmortem ethanol formation exist; however, none are completely reliable. The consumption of ethanol has been shown to alter the concentration of two major serotonin metabolites, 5-hydroxytryptophol(5-HTOL) and 5-hydroxyindole-3-acetic acid (5-HIAA). While the 5-HTOL/S-HIAA ratio is normally very low, previous studies using living subjects have demonstrated that the urinary 5-HTOL/S-HIAA ratio is significantly elevated for 11-19 hours after acute ethanol ingestion. Recently, our laboratory developed and validated an analytical method for the simultaneous determination of both 5-HTOL and 5-HIAA in forensic urine samples using a simple liquid/liquid extraction and LC/MS/MS and LC/MS/MS/MS. In this previous work, a 15 pmol/nmol serotonin metabolite ratio cutoff was established in postmortem urine, below which it could be conclusively determined that no recent antemortem ethanol consumption had occurred. In the current study, this newly validated analytical method was applied to five ethanol-positive aviation fatalities where the origin of the ethanol present could not previously be conclusively determined.
Author
Aerospace Medicine; Ethyl Alcohol; Urine; Serotonin; Mortality; Toxicology; Civil Aviation

53
BEHAVIORAL SCIENCES

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

20040110272 NASA Langley Research Center, Hampton, VA, USA
Effects of Modality on Interrupted Flight Deck Performance: Implications for Data Link
Latorella, Kara A.; [1997]; 5 pp.; In English
Contract(s)/Grant(s): NGT-50992; No Copyright; Avail: CASI; A01, Hardcopy

Externally-imposed tasks frequently interrupt ongoing task performance in the commercial flight deck. While normally managed without consequence, basic research as well as aviation accident and incident investigations show that interruptions can negatively affect performance and safety. This research investigates the influence of interruption and interrupted task modality on pilot performance in a simulated commercial flight deck. Fourteen current commercial airline pilots performed approach scenarios in a fixed-base flight simulator. Air traffic control instructions, conveyed either aurally or visually (via a data link system) interrupted a visual task (obtaining information from the Flight Management System) and an auditory task (listening to the automated terminal information service recording). Some results confirm the hypothesized performance advantage of cross-modality conditions, more compelling nature of auditory interruptions, and interruption-resistance of auditory ongoing tasks. However, taken together, results suggest the four interaction conditions had different effects on pilot performance. These results have implications for the design of data link systems, and for facilitating interruption management through interface design, aiding, and training programs.
Author
Air Traffic Control; Auditory Tasks; Visual Tasks; Pilot Performance; Flight Management Systems; Human Factors Engineering; Modal Response

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*.

20040100757 NASA Langley Research Center, Hampton, VA, USA

Performance Effects of Display Incogruity in a Digital and Analog Clock Reading Task

Comstock, J. Raymond, Jr.; Derks, Peter L.; [2004]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

In an era of increasing automation, it is important to design displays and input devices that minimize human error. In this context, information concerning the human response to the detection of incongruous information is important. Such incongruous information can be operationalized as unexpected (perhaps erroneous) information on which a decision by the human or operation by an automated system is based. In the aviation environment, decision making when faced with inadequate, incomplete, or incongruous information may occur in a failure scenario. An additional challenge facing the human operator in automated environments is maintaining alertness or vigilance. The vigilance issue is of particular concern as a factor that may interact with performance when faced with inadequate, incomplete, or incongruous information. From the literature on eye-scan behavior we know that the time spent looking at a particular display or indicator is a function of the type of information one is trying to discern from the display. For example, quick glances are all it takes for confirming that an indicator is in a normal position or range, whereas a continuous look of several seconds may be required for confirmation that a complex control input is having the desired effect. Important to consider is that while an extended look takes place, visual input from other sources may be missed. Much like an extended look, the interpretation of incongruous information may require extra time. The present experiment was designed to explore the performance consequences of a decision making task when incongruous information was presented. For this experiment a display incongruity was created on a subset of trials of a clock reading laboratory task. Display incongruity was made possible through presentation of 'impossible' times (e.g. 1:65 or 11:90). Subjects made 'same' 'different' decisions and keyboard responses to pairings of Analog-Analog (AA), Digital-Digital (DD), and Analog- Digital (AD), display combinations. For trials during which display incongruities were not presented, based on prior research comparing digital and analog clock displays, it would be expected that the Digital-Digital condition would result in the shortest response times and the Analog-Analog and Analog-Digital conditions would have longer response times. The performance consequence expected on trials with incongruous times would be very long response times. Author

Human Performance; Human Factors Engineering; Clocks

20040110681 NASA Langley Research Center, Hampton, VA, USA

Designing to Control Flight Crew Errors

Schutte, Paul C.; Willshire, Kelli F.; [1997]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

It is widely accepted that human error is a major contributing factor in aircraft accidents. There has been a significant amount of research in why these errors occurred, and many reports state that the design of flight deck can actually dispose humans to err. This research has led to the call for changes in design according to human factors and human-centered principles. The National Aeronautics and Space Administration's (NASA) Langley Research Center has initiated an effort to design a human-centered flight deck from a clean slate (i.e., without constraints of existing designs.) The effort will be based on recent research in human-centered design philosophy and mission management categories. This design will match the human's model of the mission and function of the aircraft to reduce unnatural or non-intuitive interfaces. The product of this effort will be a flight deck design description, including training and procedures, and a cross reference or paper trail back to design hypotheses, and an evaluation of the design. The present paper will discuss the philosophy, process, and status of this design effort.

Author

Human Factors Engineering; Flight Crews; Pilot Error; Cockpits; Aircraft Instruments

55
EXOBIOLOGY

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

20040095936 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Astrobiology Exploration Strategies for the Mars Polar Regions Using Balloon Platforms
Mahaffy, P. R.; Atreya, S. A.; Fairbrother, D. A.; Farrell, W. M.; Gorevan, S.; Jones, J.; Mitrofanov, I.; Scott, J.; [2003]; 2 pp.; In English; 3rd International Conference on Mars, 13-17 Oct. 2003, Alberta, Canada; Copyright; Avail: CASI; A01, Hardcopy

Montgolfiere balloons can provide a unique near-surface platform for an extended traverse over the polar regions of Mars. During the polar summer, such solar powered balloons would remain in the constant sun of the polar summer and could remain airborne for many weeks or even months as the atmospheric circulation would drive the balloons around the polar region many times before the balloon would cross the terminator. Such a platform for scientific measurements could provide in situ sampling of the atmosphere for trace disequilibrium species that might be indicators of present geological or biological activity in this regon. It could furthermore provide high resolution imaging, deep electromagnetic (EM) sounding for subsurface stratigraphy and liquid water, and high spatial resolution neutron measurements of subsurface ice. Technologies for robust balloon deployment on entry and controlled encounters with the surface and near subsurface for sample acquisition in otherwise inaccessible regions are presently being studied and developed with support from NASA.
Derived from text
Balloons; Exobiology; Mars Surface; Polar Regions; Mars Exploration; Platforms

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*.

20040100697 General Accounting Office, Washington, DC
Homeland Security. Efforts Under Way to Develop Enterprise Architecture, but Much Work Remains
Aug. 2004; 96 pp.; In English
Report No.(s): PB2004-107016; GAO-04-777; No Copyright; Avail: CASI; A05, Hardcopy

The Department of Homeland Security (DHS) is attempting to integrate 22 federal agencies, each specializing in one or more interrelated aspects of homeland security. An enterprise architecture is a key tool for effectively and efficiently accomplishing this. In September 2003, DHS issued an initial version of its architecture. Since 2002, the Office of Management and Budget (OMB) has issued various components of the Federal Enterprise Architecture (FEA), which is intended to be, among other things, a framework for informing the content of agencies' enterprise architectures. GAO was asked to determine whether the initial version of DHS's architecture (1) provides a foundation upon which to build and (2) is aligned with the FEA. GAO is making recommendations to the Secretary of Homeland Security aimed at improving the department's architecture content and development approach. GAO is also making a recommendation to the Director of OMB to clarify the expected relationship between agencies' enterprise architectures and the FEA. In comments on this report, DHS stated that it was not realistic for the initial version of its architecture to satisfy all of the key elements recommended by GAO, but that future versions would do so. OMB stated that it would address the FEA and agency architecture relationship issues that GAO reported.
NTIS
Architecture (Computers); Governments

20040100719 National Renewable Energy Lab., Golden, CO
Validation of IEEE P1547.1 Interconnection Test Procedures: ASCO 7000 Soft Load Transfer System
Kroposki, B.; Englebretson, S.; Pink, C.; Daley, J.; Siciliano, R.; Sep. 2003; In English
Report No.(s): DE2003-15004842; NREL/TP-560-34870; No Copyright; Avail: National Technical Information Service (NTIS)

This report presents the preliminary results of testing the ASCO 7000 Soft Load Transfer System according to IEEE P1547.1 procedures. The ASCO system interconnects synchronous generators with the electric power system and provides

monitoring and control for the generator and grid connection through extensive protective functions. The purpose of this testing is to evaluate and give feedback on the contents of IEEE Draft Standard P1547.1 Conformance Tests Procedures for Equipment Interconnecting Distributed Resources With Electric Power Systems.
NTIS
Electric Power Supplies; Feedback; Loads (Forces)

20040100728 NASA Langley Research Center, Hampton, VA, USA
On Managing the Use of Surrogates in General Nonlinear Optimization and MDO
Alexandrov, Natalia M.; [1998]; 10 pp.; In English
Report No.(s): AIAA Paper 98-4798; Copyright; Avail: CASI; A02, Hardcopy

This paper is concerned with a trust region approximation management framework (AMF) for solving the nonlinear programming problem in general and multidisciplinary optimization problems in particular The intent of the AMF methodology is to facilitate the solution of optimization problems with high-fidelity models. While such models are designed to approximate the physical phenomena they describe to a high degree of accuracy, their use in a repetitive procedure, for example, iterations of an optimization or a search algorithm, make such use prohibitively expensive. An improvement in design with lower-fidelity, cheaper models, however, does not guarantee a corresponding improvement for the higher-fidelity problem. The AMF methodology proposed here is based on a class of multilevel methods for constrained optimization and is designed to manage the use of variable-fidelity approximations or models in a systematic way that assures convergence to critical points of the original high-fidelity problem.
Author
Algorithms; Nonlinear Programming; Multidisciplinary Design Optimization; Approximation; Accuracy

20040110570 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, California Univ., Berkeley, CA, Pennsylvania State Univ., University Park, PA, USA
Self-Aggregation in Scaled Principal Component Space
Ding, C. H. Q.; He, X.; Zha, H.; Simon, H. D.; Oct. 05, 2001; In English
Report No.(s): DE2004-820779; No Copyright; Avail: National Technical Information Service (NTIS)

Automatic grouping of voluminous data into meaningful structures is a challenging task frequently encountered in broad areas of science, engineering and information processing. These data clustering tasks are frequently performed in Euclidean space or a subspace chosen from principal component analysis (PCA). Here we describe a space obtained by a nonlinear scaling of PCA in which data objects self-aggregate automatically into clusters. Projection into this space gives sharp distinctions among clusters. Gene expression profiles of cancer tissue subtypes, Web hyperlink structure and Internet newsgroups are analyzed to illustrate interesting properties of the space.
NTIS
Data Processing; Information Retrieval; Data Links

20040110678 Lawrence Livermore National Lab., Livermore, CA
Performance Comparison of GPFS 1.3 and GPFS 1.4 for POSIX and MPI-IO
Hedges, R. M.; Loewe, W. E.; Jul. 13, 2001; 16 pp.; In English
Report No.(s): DE2004-15007273; UCRL-ID-144548; No Copyright; Avail: Department of Energy Information Bridge

This report by the SIOP observes the effects of recent hardware and software changes for parallel I/O performance to the GPFS parallel file system. The IBM SP machine (frost) has been upgraded from Mohonk with GPFS 1.3 to Mohonk2 with GPFS 1.4. In addition, the Colony switch adapters have been upgraded from Single/Single to Double/Single. The tests discussed here were performed on frost using 60 compute nodes and the GPFS file system using 2 dedicated I/O nodes (servers). The tests performed utilize the POSIX and MPI-IO interfaces to GPFS.
NTIS
Computer Programs; Adapters

20040110679 Lawrence Livermore National Lab., Livermore, CA
LLNL High Accuracy Volume Renderer for Unstructured Data: Capabilities, Current Limits and Potential for ASCI/Views Deployment
Williams, P. L.; Max, N. L.; Jun. 04, 2001; In English
Report No.(s): DE2004-15007270; UCRL-JC-144107; No Copyright; Avail: National Technical Information Service (NTIS)

This report describes a volume rendering system for unstructured data, especially finite element data, that creates images with very high accuracy. The system will currently handle meshes whose cells are either linear or quadratic tetrahedra, or meshes with mixed cell types: tetrahedra, bricks, prisms, and pyramids. The cells may have nonplanar facets. Whenever possible, exact mathematical solutions for the radiance integrals and for interpolation are used. Accurate semitransparent shaded isosurfaces may be embedded in the volume rendering. For very small cells, subpixel accumulation by splatting is used to avoid sampling error. A new exact and efficient visibility ordering algorithm is described. The most accurate images are generated in software, however, more efficient algorithms utilizing graphics hardware may also be selected. The report describes the parallelization of the system for a distributed-shared memory multiprocessor machine, and concludes by discussing the system's limits, desirable future work, and ways to extend the system so as to be compatible with projected ASCI/VIEWS architectures.
NTIS
Algorithms; Distributed Memory; Finite Element Method; Multiprocessing (Computers)

20040110745 Argonne National Lab., IL, USA
Mace4 Reference Manual and Guide
McCune, W.; Aug. 2003; 24 pp.; In English
Report No.(s): DE2004-822574; ANL/MCS-TM-264; No Copyright; Avail: Department of Energy Information Bridge
The Multispectral Thermal Imager (MTI) is a research and development satellite sponsored by the Department of Energy (DOE) for accurate water surface temperature retrieval. MTI uses five thermal spectral bands to retrieve ground temperatures. The application of MTI for land-based temperature and emissivity retrieval has been limited. Savannah River Technology Center conducted several ground truth campaigns at Ivanpah Playa to measure reflectance, temperature and emissivity. The results of MTI temperature and emissivity retrievals and material identification will be discussed in context with the ground truth data.
NTIS
Ground Truth; Manuals; Surface Temperature; Water Temperature

20040110747 Argonne National Lab., IL, USA
Methods to Model-Check Parallel Systems Software
Matlin, O. S.; McCune, W.; Lusk, E.; Apr. 2003; 20 pp.; In English
Report No.(s): DE2004-822572; ANL/MCS-TM-261; No Copyright; Avail: Department of Energy Information Bridge
We report on an effort to develop methodologies for formal verification of parts of the Multi-Purpose Daemon (MPD) parallel process management system. MPD is a distributed collection of communicating processes. While the individual components of the collection execute simple algorithms, their interaction leads to unexpected errors that are difficult to uncover by conventional means. Two verification approaches are discussed here: the standard model checking approach using the software model checker SPIN and the nonstandard use of a general-purpose first-order resolution-style theorem prover OTTER to conduct the traditional state space exploration. We compare modeling methodology and analyze performance and scalability of the two methods with respect to verification of MPD.
NTIS
Computer Systems Programs; Program Verification (Computers); Management Systems

60
COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware and data processing. For components see *33 Electronics and Electrical Engineering*. For computer vision see *63 Cybernetics, Artificial Intelligence and Robotics*.

20040095926 NASA Langley Research Center, Hampton, VA, USA
Navier-Stokes Computations on Commodity Computers
Vatsa, Veer N.; Faulkner, Thomas R.; [1998]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy
In this paper we discuss and demonstrate the feasibility of solving high-fidelity, nonlinear computational fluid dynamics (CFD) problems of practical interest on commodity machines, namely Pentium Pro PC's. Such calculations have now become possible due to the progress in computational power and memory of the off-the-shelf commodity computers, along with the growth in bandwidth and communication speeds of networks. A widely used CFD code known as TLNS3D, which was developed originally on large shared memory computers was selected for this effort. This code has recently been ported to

massively parallel processor (MPP) type machines, where natural partitioning along grid blocks is adopted in which one or more blocks are distributed to each of the available processors. In this paper, a similar approach is adapted to port this code to a cluster of Pentium Pro computers. The message passing among the processors is accomplished through the use of standard message passing interface (MPI) libraries. Scaling studies indicate fairly high level of parallelism on such clusters of commodity machines, thus making solutions to Navier-Stokes equations for practical problems more affordable.
Author
Commodities; Communication Networks; Computational Fluid Dynamics; Navier-Stokes Equation; Feasibility Analysis; Nonlinearity

20040110239 NASA Langley Research Center, Hampton, VA, USA
Closed Form Solution for Minimum Norm Model-Validating Uncertainty
Lim, Kyong Been; [1997]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A methodology in which structured uncertainty models are directly constructed from measurement data for use in robust control design of multivariable systems is proposed. The formulation allows a general linear fractional transformation uncertainty structure connections with respect to a given nominal model. Existence conditions are given, and under mild assumptions, a closed-form expression for the smallest norm structured uncertainty that validates the model is given. The uncertainty bound computation is simple and is formulated for both open and closed loop systems.
Author
Linear Transformations; Feedback Control; Loops

20040110898 SRI International Corp., Menlo Park, CA, USA
Formalizing Space Shuttle Software Requirements
Crow, Judith; DiVito, Ben L.; [1996]; 9 pp.; In English; ACM SIGSOFT Workshop on Formal Methods in Software Practice, Jan. 1996, San Diego, CA, USA
Contract(s)/Grant(s): NAS1-19341; NAS1-20334; No Copyright; Avail: CASI; A02, Hardcopy

This paper describes two case studies in which requirements for new flight-software subsystems on NASA's Space Shuttle were analyzed, one using standard formal specification techniques, the other using state exploration. These applications serve to illustrate three main theses: (1) formal methods can complement conventional requirements analysis processes effectively, (2) formal methods confer benefits regardless of how extensively they are adopted and applied, and (3) formal methods are most effective when they are judiciously tailored to the application.
Author
Applications Programs (Computers); Computer Programming; Space Shuttle Orbiters

61
COMPUTER PROGRAMMING AND SOFTWARE

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

20040095960 USA Joint Forces Command, Norfolk, VA
The Enterprise Team: The USA Modeling and Simulation Collaboration Assistance Effort
Daniele, John; Collins, Dan; Wrigley, John; Thompson, Harry; Morgan, Nabil; Nov. 2003; 21 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425149; No Copyright; Avail: CASI; A03, Hardcopy

In the year 2000, representatives from the U.S. Joint Forces Command (USJFCOM), U.S. NAVAIR Orlando Training Systems Division (TSD), and U.S. Army Simulation, Training, and Instrumentation Command (STRICOM), working on different programs but supporting the same Partnership for Peace (PfP) nations, discovered that they had overlapping goals and were using common resources. Representatives from these organizations decided they could better serve U.S. interests, save resources, and provide more capable, integrated and interoperable systems if they coordinated their efforts. Another impetus to working cooperatively was the establishment of USJFCOM as the lead agent for the Regional Security Cooperation Network (RSCN). The RSCN was designed to facilitate coalition-based distributed education and training, building on existing information technology efforts. As a result, representatives from these three organizations decided to form the Enterprise Team to better cooperate while implementing their individual programs. This informal team meets periodically to brief the members on their individual programs and look for ways to support each other's security assistance programs. The

Enterprise Team's primary product is integrated, interoperable systems that support national security objectives and facilitate international cooperation. The U.S. Air Force Electronic Systems Center and U.S. Modeling and Simulation Information Analysis Center (MSIAC) joined the team in 2001 and 2002, respectively. Of note, each organization maintains control of its programs while supporting the overall team objectives. The benefits of Enterprise Team activity are clear: each organization brings unique capabilities and different perspectives, resulting in a Big Picture approach to meeting national and regional security objectives. The remainder of the paper outlines the key security assistance programs supported by the Enterprise Team organizations. Ten briefing charts are included. (4 refs.) 7

DTIC

Computer Assisted Instruction; Computerized Simulation; Education; Military Operations; Security; Simulation; United States

20040100746 Indiana Univ., South Bend, IN, USA

Hardware Verification Using Coinductive Assertions

Miner, Paul S.; June 1998; 153 pp.; In English; Copyright; Avail: Other Sources

Systems of mutually recursive stream equations provide a concise model of digital hardware designs. The formal design algebra presented by Johnson illustrates the utility of this representation for design derivation. The design derivation approach has been mechanized by Bose and applied to significant case studies. However, a design optimization sometimes depends upon the semantics of the implemented function. This cannot be captured within the design algebra. Design derivation needs to be augmented with additional verification strategies. The stream equations employed in the design derivation approach are an instance of definition by corecursion. Therefore, the design derivation approach may be augmented using proof by coinduction. Coinduction is a useful strategy for proving that two sequential hardware designs have the same behavior. This enables safe substitution of an innovative optimization into a mature design. Furthermore, coinduction is useful for establishing that a signals within a design satisfy invariant properties. Such invariants, called coinductive assertions, are essential to ensure the validity of aggressive design optimizations. This dissertation illustrates how design derivation is augmented using the Prototype Verification System (PVS). A PVS library to provide the basic declarations needed for reasoning about streams is developed. Stream equations are defined using corecursion, and equality between streams is proven using coinduction. The combination of derivation-based and theorem prover-based verification is illustrated using two significant examples. First, a fault-tolerant clock synchronization circuit, suitable for use in critical applications, is developed using this combined approach. A clever optimization that reduces the chip area is verified using coinductive proof within PVS. The second example is the development of an architecture for floating-point division. A number of optimizations that reduce the cycle time of the inner loop of the algorithm are verified using the combined approach.

Author

Optimization; Computer Systems Design; Program Verification (Computers); Design Analysis; Architecture (Computers); Computer Programming; Recursive Functions

20040100805 NASA Langley Research Center, Hampton, VA, USA

Desktop Access to Full-Text NACA and NASA Reports: Systems Developed by NASA Langley Technical Library

Ambur, Manjula Y.; Adams, David L.; Trinidad, P. Paul; [1997]; 12 pp.; In English; 35th Aerospace Sciences Meetings and Exhibit, 6-10 Jan. 1997, Reno, NV, USA

Report No.(s): AIAA Paper 97-0467; Copyright; Avail: CASI; A03, Hardcopy

NASA Langley Technical Library has been involved in developing systems for full-text information delivery of NACA/NASA technical reports since 1991. This paper will describe the two prototypes it has developed and the present production system configuration. The prototype systems are a NACA CD-ROM of thirty-three classic paper NACA reports and a network-based Full-text Electronic Reports Documents System (FEDS) constructed from both paper and electronic formats of NACA and NASA reports. The production system is the DigiDoc System (DIGItal Documents) presently being developed based on the experiences gained from the two prototypes. DigiDoc configuration integrates the on-line catalog database World Wide Web interface and PDF technology to provide a powerful and flexible search and retrieval system. It describes in detail significant achievements and lessons learned in terms of data conversion, storage technologies, full-text searching and retrieval, and image databases. The conclusions from the experiences of digitization and full- text access and future plans for DigiDoc system implementation are discussed.

Author

Data Conversion Routines; Information Retrieval; Computer Programs

20040105595 National Academy of Sciences - National Research Council, Hampton, VA, USA
An Improved Treatment of External Boundary for Three-Dimensional Flow Computations
Tsynkov, Semyon V.; Vatsa, Veer N.; [1997]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

We present an innovative numerical approach for setting highly accurate nonlocal boundary conditions at the external computational boundaries when calculating three-dimensional compressible viscous flows over finite bodies. The approach is based on application of the difference potentials method by V. S. Ryaben'kii and extends our previous technique developed for the two-dimensional case. The new boundary conditions methodology has been successfully combined with the NASA-developed code TLNS3D and used for the analysis of wing-shaped configurations in subsonic and transonic flow regimes. As demonstrated by the computational experiments, the improved external boundary conditions allow one to greatly reduce the size of the computational domain while still maintaining high accuracy of the numerical solution. Moreover, they may provide for a noticeable speedup of convergence of the multigrid iterations.
Author
Computational Fluid Dynamics; Numerical Analysis; Boundary Conditions; Boundary Layer Flow; Three Dimensional Flow

20040105618 NASA Langley Research Center, Hampton, VA, USA
SimGraph: A Flight Simulation Data Visualization Workstation
Kaplan, Joseph A.; Kenney, Patrick S.; [1997]; 10 pp.; In English
Report No.(s): AIAA Paper 97-3797; Copyright; Avail: CASI; A02, Hardcopy

Today's modern flight simulation research produces vast amounts of time sensitive data, making a qualitative analysis of the data difficult while it remains in a numerical representation. Therefore, a method of merging related data together and presenting it to the user in a more comprehensible format is necessary. Simulation Graphics (SimGraph) is an object-oriented data visualization software package that presents simulation data in animated graphical displays for easy interpretation. Data produced from a flight simulation is presented by SimGraph in several different formats, including: 3-Dimensional Views, Cockpit Control Views, Heads-Up Displays, Strip Charts, and Status Indicators. SimGraph can accommodate the addition of new graphical displays to allow the software to be customized to each user s particular environment. A new display can be developed and added to SimGraph without having to design a new application, allowing the graphics programmer to focus on the development of the graphical display. The SimGraph framework can be reused for a wide variety of visualization tasks. Although it was created for the flight simulation facilities at NASA Langley Research Center, SimGraph can be reconfigured to almost any data visualization environment. This paper describes the capabilities and operations of SimGraph.
Author
Applications Programs (Computers); Display Devices; Object-Oriented Programming; Workstations; Flight Simulation

20040105658 NASA Langley Research Center, Hampton, VA, USA
Closed-Loop HIRF Experiments Performed on a Fault Tolerant Flight Control Computer
Belcastro, Celeste M.; [1997]; 15 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

ABSTRACT Closed-loop HIRF experiments were performed on a fault tolerant flight control computer (FCC) at the NASA Langley Research Center. The FCC used in the experiments was a quad-redundant flight control computer executing B737 Autoland control laws. The FCC was placed in one of the mode-stirred reverberation chambers in the HIRF Laboratory and interfaced to a computer simulation of the B737 flight dynamics, engines, sensors, actuators, and atmosphere in the Closed-Loop Systems Laboratory. Disturbances to the aircraft associated with wind gusts and turbulence were simulated during tests. Electrical isolation between the FCC under test and the simulation computer was achieved via a fiber optic interface for the analog and discrete signals. Closed-loop operation of the FCC enabled flight dynamics and atmospheric disturbances affecting the aircraft to be represented during tests. Upset was induced in the FCC as a result of exposure to HIRF, and the effect of upset on the simulated flight of the aircraft was observed and recorded. This paper presents a description of these closed- loop HIRF experiments, upset data obtained from the FCC during these experiments, and closed-loop effects on the simulated flight of the aircraft.
Author
Closed Cycles; Computerized Simulation; Automatic Landing Control; Feedback Control; Airborne/Spaceborne Computers

20040105661 NASA Langley Research Center, Hampton, VA, USA
Why Engineers Should Consider Formal Methods
Holloway, C. Michael; [1997]; 7 pp.; In English; 16th Digital Avionics Systems Conference, Oct, 1997; No Copyright; Avail: CASI; A02, Hardcopy

This paper presents a logical analysis of a typical argument favoring the use of formal methods for software development, and suggests an alternative argument that is simpler and stronger than the typical one.
Author
Engineers; Software Engineering; Formalism

20040110241 NASA Langley Research Center, Hampton, VA, USA
Evaluation of Honeywell Recoverable Computer System (RCS) in Presence of Electromagnetic Effects
Malekpour, Mahyar; [1997]; 7 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The design and development of a Closed-Loop System to study and evaluate the performance of the Honeywell Recoverable Computer System (RCS) in electromagnetic environments (EME) is presented. The development of a Windows-based software package to handle the time critical communication of data and commands between the RCS and flight simulation code in real-time, while meeting the stringent hard deadlines is also presented. The performance results of the RCS while exercising flight control laws under ideal conditions as well as in the presence of electromagnetic fields is also discussed.
Author
Applications Programs (Computers); Computerized Simulation; Electromagnetic Fields; Honeywell Computers

20040110277 INVOCON, Conroe, TX, USA
PSAW/MicroSWIS [Microminiature Surface Acoustic Wave (SAW) based Wirelesss Instrumentation System]
Heermann, Doug; Krug, Eric; September 03, 2004; 59 pp.; In English
Contract(s)/Grant(s): NAS3-01118
Report No.(s): IVC-1420026; No Copyright; Avail: CASI; A04, Hardcopy

This Final Report for the PSAW/MicroSWIS Program is provided in compliance with contract number NAS3-01118. This report documents the overall progress of the program and presents project objectives, work carried out, and results obtained. Program Conceptual Design Package stated the following objectives: To develop a sensor/transceiver network that can support networking operations within spacecraft with sufficient bandwidth so that (1) flight control data, (2) avionics data, (3) payload/experiment data, and (4) prognostic health monitoring sensory information can flow to appropriate locations at frequencies that contain the maximum amount of information content but require minimum interconnect and power: a very high speed, low power, programmable modulation, spread-spectrum radio sensor/transceiver.
Author
Computer Systems Design; Programmable Logic Devices; Microminiaturization; Transmitter Receivers; Microelectronics; Signal Processing; Spread Spectrum Transmission

20040110309 NASA Langley Research Center, Hampton, VA, USA
Computation of LFT Uncertainty Bounds with Repeated Parametric Uncertainties
Lim, K. B.; Giesy, D. P.; [1997]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A new methodology in which linear fractional transformation uncertainty bounds are directly constructed for use in robust control design and analysis is proposed. Existence conditions for model validating solutions with or without repeated scalar uncertainty are given. The approach is based on minimax formulation to deal with multiple non-repeated structured uncertainty components subject to fixed levels of repeated scalar uncertainties. Input directional dependence and variations with different experiments are addressed by maximizing uncertainty levels over multiple experimental data sets. Preliminary results show that reasonable uncertainty bounds on structured non-repeated uncertainties can be identified directly from measurement data by assuming reasonable levels of repeated scalar uncertainties.
Author
Linear Transformations; Control Systems Design; Technology Assessment

20040110314 NASA Langley Research Center, Hampton, VA, USA
A Novel Solution-Technique Applied to a Novel WAAS Architecture
Bavuso, J.; [1998]; 6 pp.; In English
Report No.(s): Rept-98RM-014; No Copyright; Avail: CASI; A02, Hardcopy

The Federal Aviation Administration has embarked on an historic task of modernizing and significantly improving the national air transportation system. One system that uses the Global Positioning System (GPS) to determine aircraft navigational information is called the Wide Area Augmentation System (WAAS). This paper describes a reliability assessment

of one candidate system architecture for the WAAS. A unique aspect of this study regards the modeling and solution of a candidate system that allows a novel cold sparing scheme. The cold spare is a WAAS communications satellite that is fabricated and launched after a predetermined number of orbiting satellite failures have occurred and after some stochastic fabrication time transpires. Because these satellites are complex systems with redundant components, they exhibit an increasing failure rate with a Weibull time to failure distribution. Moreover, the cold spare satellite build-time is Weibull and upon launch is considered to be a good-as-new system with an increasing failure rate and a Weibull time to failure distribution as well. The reliability model for this system is non-Markovian because three distinct system clocks are required: the time to failure of the orbiting satellites, the build time for the cold spare, and the time to failure for the launched spare satellite. A powerful dynamic fault tree modeling notation and Monte Carlo simulation technique with importance sampling are shown to arrive at a reliability prediction for a 10 year mission.
Author
Architecture (Computers); Augmentation; Global Positioning System; Performance Prediction

20040110327 NASA Langley Research Center, Hampton, VA, USA
Response Surface Model Building Using Orthogonal Arrays for Computer Experiments
Unal, Resit; Braun, Robert D.; Moore, Arlene A.; Lepsch, Roger A.; [1997]; 13 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

This study investigates response surface methods for computer experiments and discusses some of the approaches available. Orthogonal arrays constructed for computer experiments are studied and an example application to a technology selection and optimization study for a reusable launch vehicle is presented.
Author
Ground Tests; Computer Design

20040110328 NASA Langley Research Center, Hampton, VA, USA
Computational Diagnostic Techniques for Electromagnetic Scattering: Analytical Imaging, Near Fields, and Surface Currents
Hom, Kam W.; Talcott, Noel A., Jr.; Shaeffer, John; [1997]; 7 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

This paper presents three techniques and the graphics implementations which can be used as diagnostic aides in the design and understanding of scattering structures: Imaging, near fields, and surface current displays. The imaging analysis is a new bistatic k space approach which has potential for much greater information than standard experimental approaches. The near field and current analysis are implementations of standard theory while the diagnostic graphics displays are implementations exploiting recent computer engineering work station graphics libraries.
Author
Computation; Diagnosis; Electromagnetic Scattering; Computer Graphics

20040110339 NASA Langley Research Center, Hampton, VA, USA
Reducing Design Cycle Time and Cost Through Process Resequencing
Rogers, James L.; [2004]; 6 pp.; In English; International Conference on Engineering Design Iced 97, 19-21 Aug. 1997, Tampere, Finland; No Copyright; Avail: CASI; A02, Hardcopy

In today's competitive environment, companies are under enormous pressure to reduce the time and cost of their design cycle. One method for reducing both time and cost is to develop an understanding of the flow of the design processes and the effects of the iterative subcycles that are found in complex design projects. Once these aspects are understood, the design manager can make decisions that take advantage of decomposition, concurrent engineering, and parallel processing techniques to reduce the total time and the total cost of the design cycle. One software tool that can aid in this decision-making process is the Design Manager's Aid for Intelligent Decomposition (DeMAID). The DeMAID software minimizes the feedback couplings that create iterative subcycles, groups processes into iterative subcycles, and decomposes the subcycles into a hierarchical structure. The real benefits of producing the best design in the least time and at a minimum cost are obtained from sequencing the processes in the subcycles.
Derived from text
Cost Reduction; Concurrent Engineering; Genetic Algorithms; Computer Systems Programs; Artificial Intelligence

20040110369 NASA Langley Research Center, Hampton, VA, USA
Distributed-Memory Computing With the Langley Aerothermodynamic Upwind Relaxation Algorithm (LAURA)
Riley, Christopher J.; Cheatwood, F. McNeil; [1997]; 9 pp.; In English; 4th NASA National Symposium on Large-Scale

Analysis and Design on High-Performance Computers and Workstations, 15-17 Oct. 1997, Williamsburg, VA, USA; No Copyright; Avail: CASI; A02, Hardcopy

The Langley Aerothermodynamic Upwind Relaxation Algorithm (LAURA), a Navier-Stokes solver, has been modified for use in a parallel, distributed-memory environment using the Message-Passing Interface (MPI) standard. A standard domain decomposition strategy is used in which the computational domain is divided into subdomains with each subdomain assigned to a processor. Performance is examined on dedicated parallel machines and a network of desktop workstations. The effect of domain decomposition and frequency of boundary updates on performance and convergence is also examined for several realistic configurations and conditions typical of large-scale computational fluid dynamic analysis.

Author

Computer Programs; Algorithms; Distributed Memory; Aerothermodynamics

20040110426 NASA Langley Research Center, Hampton, VA, USA

TRSkit: A Simple Digital Library Toolkit

Nelson, Michael L.; Esler, Sandra L.; Journal of Internet Cataloging; 1997; Volume 1, No. 2, pp. 41-55; In English; Copyright; Avail: CASI; A02, Hardcopy

This paper introduces TRSkit, a simple and effective toolkit for building digital libraries on the World Wide Web. The toolkit was developed for the creation of the Langley Technical Report Server and the NASA Technical Report Server, but is applicable to most simple distribution paradigms. TRSkit contains a handful of freely available software components designed to be run under the UNIX operating system and served via the World Wide Web. The intended customer is the person that must continuously and synchronously distribute anywhere from 100 - 100,000's of information units and does not have extensive resources to devote to the problem.

Author

Computer Programs; Unix (Operating System); World Wide Web; Software Development Tools

20040110431 NASA Langley Research Center, Hampton, VA, USA

Application of Normal Mode Expansion to AE Waves in Finite Plates

Gorman, M. R.; Prosser, W. H.; [1997]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Breckenridge et al. (1975), Hsu (1985) and Pao (1978) adapted approaches from seismology to calculate the response at the surface of an infinite half-space and an infinite plate. These approaches have found use in calibrating acoustic emission (AE) transducers. However, it is difficult to extend this theoretical approach to AE testing of practical structures. Weaver and Pao (1982) considered a normal mode solution to the Lamb equations. Hutchinson (1983) pointed out the potential relevance of Mindlin's plate theory (1951) to AE. Pao (1982) reviewed Medick s (1961) classical plate theory for a point source, but rejected it as useful for AE and no one seems to have investigated its relevance to AE any further. Herein, a normal mode solution to the classical plate bending equation was investigated for its applicability to AE. The same source-time function chosen by Weaver and Pao is considered. However, arbitrary source and receiver positions are chosen relative to the boundaries of the plate. This is another advantage of the plate theory treatment in addition to its simplicity. The source does not have to be at the center of the plate as in the axisymmetric treatment. The plate is allowed to remain finite and reflections are predicted. The importance of this theory to AE is that it can handle finite plates, realistic boundary conditions, and can be extended to composite materials.

Author

Acoustic Emission; Computation; Seismology; Plate Theory

20040110467 Turkish Naval Headquarters, Ankara

Combat Modeling by Using Simulation Components

Kulac, Oray; Gunal, Murat; Oct. 2002; 21 pp.; In English; Original contains color illustrations

Report No.(s): AD-A425263; No Copyright; Avail: CASI; A03, Hardcopy

Growing cost of operational trials and limited budgets make extensive live tests of military systems and frequent live exercises nearly impossible. Also defense planning dealing with extremely complex military system behaviors necessitates the utilization of innovative analysis tools. Simulation is one of the most employed tools for the military analyses training and acquisition. Its increasing importance is now well- recognized in most of the armed forces and in NATO. Dramatic advances are being made in military simulation community but these advances are associated mainly with computer technologies. Modeling and simulation efforts are subject to some problems. First of all building and using a simulation model is an expensive and laborious activity. It is difficult to design a model to efficiently and effectively support the appropriate analyses.

Also models are generally built in closed architectures and are difficult to adapt to the specifics of different however related analysis efforts. Turkish Navy has started a research project in order to minimize above deficiencies. This research effort concerns at first with the simulation model infrastructure and then the model itself) The research on simulation model infrastructure exploits the theory and methodology that will make it possible to design and conflict reusable and flexible models. The results of this study are going to be the development of a flexible scalable and reusable tool that can be used for the construction of a library of Naval combat model components. The JAVAT programming language has been chosen for implementation in order to take advantage of world-wide web. The purpose of Operations Research (OR) type of combat components is to provide a library of reusable software to speed development of OR applications and make them more reliable.
DTIC
Combat; Computer Programs; Programming Languages; Simulation

20040110493 Air Force Inst. of Tech., Wright-Patterson AFB, OH
Cross-Sectional Study on the Factors that Influence E-Learning Course Completion Rates
Earnhardt, Christopher C.; Mar. 2004; 104 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425320; AFIT/GIR/ENV/04M-05; No Copyright; Avail: CASI; A06, Hardcopy

Completion rates for web-based courses tend to lag behind their traditional classroom counterparts, sometimes as much as 40% (Carter, 1996; Phipps and Merisotis, 1999; Zielinski, 2000). Thurston and Reynolds (2002) employed motivational constructs to explain why some people persist while others drop out of web-based courses. Their analysis of 8 web-based courses and response from 497 active duty Air Force students indicated that completion goals, off-task distractions, availability of feedback for self-regulation, and continued confidence were important factors that distinguished those who completed their courses from those who did not. This study addresses the limitations of the previous study and then expands beyond persistence to assess the influence of motivational factors of on transfer of learning to the work environment and intentions to pursue e-learning courses in the future. A survey was administered to 1,946 active duty and civilian students who had enrolled in one of the 20 courses offered by the Air Force Institute of Technology s Virtual Schoolhouse. Results were analyzed using the LISREL (Joreskog and Sorbom, 1993) structural equational modeling program. Analysis of the 791 usable responses provided strong evidence for the hypothesized relationships. Practical and theoretical implications of this research are discussed.
DTIC
Computer Assisted Instruction; Education

20040110499 Human Resources Research Organization, Alexandria, VA
Knowledge Networks for Future Force Training: Illustration of Searching, Retrieval, and Communication Concepts
Wall, James A.; Elms, Randle D.; Biggers, Keith E.; Sticha, Paul J.; Jun. 2004; 66 pp.; In English
Contract(s)/Grant(s): DASW01-99-D-0012; DELIVERY ORDER 0019; Proj-A792
Report No.(s): AD-A425353; ARI-RR-1823; No Copyright; Avail: CASI; A04, Hardcopy

U.S. Army units are transforming to become a lighter, more mobile Future Force that can operate within joint and coalition environments. To enable Future Force units to achieve successful deployment, the Army is developing knowledge networks to provide access to a wide range of information across military operations. To use the vast amount of available information effectively, knowledge networks must include procedures that organize information, identify the most relevant information to meet a user request, authenticate retrieved information, and allow the user to add new information to the network. This project develops and demonstrates a prototype knowledge network that illustrates methods to retrieve information needed to facilitate mission accomplishment, and to share this information among Soldiers and units. This research began with an information engineering activity that analyzed the functions and tasks of Future Force units to identify information requirements. The effort proceeded to develop a prototype knowledge network incorporating relevant existing technologies, including (a) Web crawlers, (b) searching and indexing, (c) rich site summary news feeds, (d) Web logs, (e) user profiling, and (f) personal messaging. The prototype was demonstrated to four Army officers and enlisted personnel, whose impressions provided feedback used to revise the prototype and to make recommendations for future system enhancements.
DTIC
Computer Networks; Knowledge Based Systems; Telecommunication

20040110500 Human Resources Research Organization, Alexandria, VA
Update of U.S. Army Research Institute's Officer Personnel Research Data Bases for 2001 and 2002
Young, Winnie Y.; Jun. 2004; 129 pp.; In English
Contract(s)/Grant(s): DASW01-98-D-0047; DELIVERY ORDER 0048; Proj-20665803D730
Report No.(s): AD-A425354; No Copyright; Avail: CASI; A07, Hardcopy

This document describes the procedures performed to add 2001 and 2002 personnel data to the Longitudinal and Core data sets of the U.S. Army Research Institute's Officer Longitudinal Research Data Base (OLRDB) and to the Core Data Set of the Officer Standardized Educational Testing Data Base (OSETDB). These data sets were designed for research purposes and contain historical and current data on U. S. Army commissioned officer personnel. The OLRDB contains career history data primarily from the 1979 through 2002 Officer Master Files (OMF) and the Separation Officer Master Files (SOMF). The OSETDB contains academic measures for officer personnel commissioned between 1980 and 1990. In particular, the testing data includes Scholastic Aptitude Test (SAT) scores from the Educational Testing Service and American College Test (ACT) scores from the American College Testing Program for academic years 1973 through 1985.
DTIC
Data Bases; Maintenance; Personnel

20040110501 Massachusetts Univ., Amherst, MA
Building and Acquiring Interactionist Ontologies
Cohen, Paul R.; Dec. 14, 2002; 68 pp.; In English
Contract(s)/Grant(s): F49620-97-1-0485
Report No.(s): AD-A425355; No Copyright; Avail: CASI; A04, Hardcopy

Our HPKB effort was intended to determine whether physical schemas could be a semantic core for ontologies. This report describes the basic theory of physical schema and our work on re-use of knowledge from ontologies. An addendum to the report is a published summary of all the research in the entire HPKB program written by Prof. Cohen (first author) and many of the HPKB principals.
DTIC
Knowledge Based Systems; Problem Solving

20040110510
Coated and Uncoated Models; What is the Difference? An Odyssey in Ten Parts
Maidanik, G.; Becker, K. J.; Maga, L. J.; Aug. 2004; 50 pp.; In English
Report No.(s): AD-A425381; NSWCCD-70-TR-2004/114; No Copyright; Avail: CASI; A03, Hardcopy

The advent of computers with super memories and manipulative capabilities led to several all-purpose computer programs that can extensively estimate the responses of externally driven complex dynamic systems. The estimates are computed with relative ease and are richly displayed. In these all-purpose computer programs an attempt is made a priori to achieve one-to-one correspondence with data derived off fully fledged dynamic systems. This is the good news. The bad news is that often enough the results issued by these computer programs are difficult to interpret and diagnose. Indeed, the discrepancies between data taken off fully fledged dynamic systems and the corresponding results issued by the all- purpose computer programs are often not amenable to causes and assignments. To subdue some of the bad news, it helps to construct and analyze simpler dynamic systems that are subjected to simpler sets of external drives. In this endeavor, the comparison between data and results are sought on the basis of phenomenological correspondence, notwithstanding that some significant features that are exhibited by the data derived off dynamic systems may not necessarily partake in this phenomenological correspondence. The phenomenological correspondence is often derived from fully fledged dynamic systems that are generic models of the actual dynamic systems.
DTIC
Architecture (Computers); Coatings

20040110518 Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA
User Manual for the Dismounted Infantry Virtual After Action Review System (DIVAARS) (User Manual)
Clark, Bryan R.; Lampton, Donald R.; Martin, Glenn A.; Bliss, James P.; Jun. 2004; 35 pp.; In English
Contract(s)/Grant(s): Proj-2O262785A790
Report No.(s): AD-A425427; ARI-RP-2004-03; No Copyright; Avail: CASI; A03, Hardcopy

This product includes the operator's manual for the Dismounted Infantry Virtual After Action Review System

(DIVAARS). The 16-page manual provides complete instructions for the installation and use of the DIVAARS software. Along with the manual, a description is presented of why and how the manual was developed, including a detailed account of usability testing. Information about obtaining the DIVAARS software is included. DIVAARS can function as the After Acton Review system for any exercise conducted with Distributed Interactive Simulation (DIS) compliant systems. Examples of DIS systems are: the Squad Synthetic Environment (SSE), Virtual Emergency Response Training System (VERTS), and the Fully Immersive Team Training (FITT) system. DIVAARS is especially useful for training small teams that operate on foot (versus from within vehicles) and in urban areas (including operations inside of buildings). DIVAARS requires a dual Pentium III, 1.0GHZ PC (or single equivalent processor, e. g., Pentum 4,2.0GHZ), 512MB RAM, 40GB drive, and a hardware- accelerated video card (e.g. nVidia GeForce 4). DIVAARS runs on Red Hat Linux (version 8.0 or 9). Other software requirements (freeware via World Wide Web) include the Virtual Environment Software Sandbox 3.0.0, Open Scene Graph 0.9.6, and OpenAL.
DTIC
Computer Programs; Manuals; Personnel; User Manuals (Computer Programs); Virtual Reality

20040110744 NASA Langley Research Center, Hampton, VA, USA
Rapid Modeling, Assembly and Simulation in Design Optimization
Housner, Jerry; [1997]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A new capability for design is reviewed. This capability provides for rapid assembly of detail finite element models early in the design process where costs are most effectively impacted. This creates an engineering environment which enables comprehensive analysis and design optimization early in the design process. Graphical interactive computing makes it possible for the engineer to interact with the design while performing comprehensive design studies. This rapid assembly capability is enabled by the use of Interface Technology, to couple independently created models which can be archived and made accessible to the designer. Results are presented to demonstrate the capability.
Author
Design Optimization; Finite Element Method; Models

20040110810 NASA Langley Research Center, Hampton, VA, USA
Verification of IEEE Compliant Subtractive Division Algorithms
Miner, Paul S.; Leathrum, James F., Jr.; [1996]; 16 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

A parameterized definition of subtractive floating point division algorithms is presented and verified using PVS. The general algorithm is proven to satisfy a formal definition of an IEEE standard for floating point arithmetic. The utility of the general specification is illustrated using a number of different instances of the general algorithm.
Author
Algorithms; Floating Point Arithmetic; Subtraction

20040110891 NASA Langley Research Center, Hampton, VA, USA
DeMAID/GA an Enhanced Design Manager's Aid for Intelligent Decomposition
Rogers, J. L.; [1996]; 8 pp.; In English
Report No.(s): AIAA-96-4157; Copyright; Avail: CASI; A02, Hardcopy

Many companies are looking for new tools and techniques to aid a design manager in making decisions that can reduce the time and cost of a design cycle. One tool is the Design Manager's Aid for Intelligent Decomposition (DeMAID). Since the initial public release of DeMAID in 1989, much research has been done in the areas of decomposition, concurrent engineering, parallel processing, and process management; many new tools and techniques have emerged. Based on these recent research and development efforts, numerous enhancements have been added to DeMAID to further aid the design manager in saving both cost and time in a design cycle. The key enhancement, a genetic algorithm (GA), will be available in the next public release called DeMAID/GA. The GA sequences the design processes to minimize the cost and time in converging a solution. The major enhancements in the upgrade of DeMAID to DeMAID/GA are discussed in this paper. A sample conceptual design project is used to show how these enhancements can be applied to improve the design cycle.
Author
Computer Programs; Genetic Algorithms; Design Analysis

20040110945 NASA Langley Research Center, Hampton, VA, USA
Use of the Collaborative Optimization Architecture for Launch Vehicle Design
Braun, R. D.; Moore, A. A.; Kroo, I. M.; [1996]; 13 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Collaborative optimization is a new design architecture specifically created for large-scale distributed-analysis applications. In this approach, problem is decomposed into a user-defined number of subspace optimization problems that are driven towards interdisciplinary compatibility and the appropriate solution by a system-level coordination process. This decentralized design strategy allows domain-specific issues to be accommodated by disciplinary analysts, while requiring interdisciplinary decisions to be reached by consensus. The present investigation focuses on application of the collaborative optimization architecture to the multidisciplinary design of a single-stage-to-orbit launch vehicle. Vehicle design, trajectory, and cost issues are directly modeled. Posed to suit the collaborative architecture, the design problem is characterized by 5 design variables and 16 constraints. Numerous collaborative solutions are obtained. Comparison of these solutions demonstrates the influence which an priori ascent-abort criterion has on development cost. Similarly, objective-function selection is discussed, demonstrating the difference between minimum weight and minimum cost concepts. The operational advantages of the collaborative optimization
Author
Launch Vehicles; Design Optimization; Optimization; Architecture (Computers)

20040110966 Vigyan Research Associates, Inc., Hampton, VA, USA
Formalizing New Navigation Requirements for NASA's Space Shuttle
DiVito, Ben L.; [1996]; 19 pp.; In English
Contract(s)/Grant(s): NAS1-19341; Copyright; Avail: CASI; A03, Hardcopy

We describe a recent NASA-sponsored pilot project intended to gauge the effectiveness of using formal methods in Space Shuttle software requirements analysis. Several Change Requests (CRs) were selected as promising targets to demonstrate the utility of formal methods in this demanding application domain. A CR to add new navigation capabilities to the Shuttle, based on Global Positioning System (GPS) technology, is the focus of this industrial usage report. Portions of the GPS CR were modeled using the language of SRI's Prototype Verification System (PVS). During a limited analysis conducted on the formal specifications, numerous requirements issues were discovered. We present a summary of these encouraging results and conclusions we have drawn from the pilot project.
Author
Software Engineering; Space Shuttle Orbiters; Spacecraft Guidance; Formalism

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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.

20040110344 NASA Langley Research Center, Hampton, VA, USA
Discussion of DNS: Past, Present, and Future
Joslin, Ronald D.; [1997]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This paper covers the review, status, and projected future of direct numerical simulation (DNS) methodology relative to the state-of-the-art in computer technology, numerical methods, and the trends in fundamental research programs.
Author
Direct Numerical Simulation; Computational Fluid Dynamics; Algorithms; Computer Systems Design

20040110420 NASA Langley Research Center, Hampton, VA, USA
Performance Comparison of a Set of Periodic and Non-Periodic Tridiagonal Solvers on SP2 and Paragon Parallel Computers
Sun, Xian-He; Moitra, Stuti; [1996]; 25 pp.; In English
Contract(s)/Grant(s): NAS1-1672; No Copyright; Avail: CASI; A03, Hardcopy

Various tridiagonal solvers have been proposed in recent years for different parallel platforms. In this paper, the performance of three tridiagonal solvers, namely, the parallel partition LU algorithm, the parallel diagonal dominant algorithm, and the reduced diagonal dominant algorithm, is studied. These algorithms are designed for distributed-memory machines and are tested on an Intel Paragon and an IBM SP2 machines. Measured results are reported in terms of execution time and speedup. Analytical study are conducted for different communication topologies and for different tridiagonal systems. The

measured results match the analytical results closely. In addition to address implementation issues, performance considerations such as problem sizes and models of speedup are also discussed.
Author
Parallel Computers; Supercomputers; Performance Tests; Algorithms

20040110498 Air Force Inst. of Tech., Wright-Patterson AFB, OH
Cyber Warfare: Raising Information Security to a Top Priority
Knapp, Kenneth J.; Jul. 22, 2004; 34 pp.; In English
Report No.(s): AD-A425352; No Copyright; Avail: CASI; A03, Hardcopy

Beyond the media hype, information warfare has become a central concern of the Internet age. While not denying the obvious military implications, a 15-year review (1990-2004) of information conflict reveals twelve characteristics and trends that affect civilian communities as well. For example, there is the growing availability of low- cost cyber weaponry on the Internet as modern societies increasingly rely on information infrastructures, and civilian organizations become the primary targets of attacks. Additionally, information warfare encompasses such domains as espionage, media perception, nation-state relations, and transnational criminal activities. As information conflict becomes a growing concern, managers must understand this reality and plan to defend against attacks. As a conclusion, this article provides a summary of the twelve selected characteristics of information conflict and offers a comprehensive strategy to promote effective information security in organizations.
DTIC
Priorities; Security; Warfare

20040110515 Georgia Tech Research Inst., Atlanta, GA
An Interactive, Distributed, Computational Environment for the Design of Multi-Functional Materials and Processes
Mistree, Farrokh; McDowell, David L.; Jul. 15, 2004; 3 pp.; In English
Contract(s)/Grant(s): F49620-03-1-0348
Report No.(s): AD-A425404; AFOSR-0348-7/15/04-FINAL; AFRL-SR-AR-TR-04-0412; No Copyright; Avail: CASI; A01, Hardcopy

Preliminary studies needed to develop and deploy a domain-independent computational framework for the interactive, collaborative design and manufacture of multifunctional materials in a distributed product realization environment were performed. The framework supports systems-based material design initiatives including an on-going AFOSR MURI (AFOSR 1606U81) and can also be used to support projects within the AFOSR MEANS program. The following tasks were completed: (i) A domain-independent computational framework was developed and demonstrated for multi-functional heat exchangers. (ii) Simulation models and databases developed by the MURI team were deployed so that they can be accessed remotely over the web. (iii) A STEP standard based database for capturing design information for Linear Cellular Alloys was developed (iv) An overview/video of real-time, distributed, simulation-based design was presented at the AFOSR Workshop 8/8/2003 in Boulder, Colorado. (v) The basic architecture of digital interfaces to support different perspectives of the stakeholders in a design process was developed and methods for facilitating collaboration were developed. (vi) A web-server to support collaboration within our MURI http:// www.afosrmuri.gatech. edu/ was developed. This includes information about people, presentations, publications, the X-DPR software and a web- board with permission control.
DTIC
Design Analysis

20040110692 NASA Goddard Space Flight Center, Greenbelt, MD, USA
CCSDS File Delivery Protocol for Flight Applications
Ferrer, Art; May 20, 2004; 9 pp.; In English; Fourth Space Internet Workshop, 8-10 Jun. 2004, Hanover, MD, USA; No Copyright; Avail: CASI; A02, Hardcopy

This viewgraph presentation addresses the development of an Internet protocol for space missions.
CASI
Internets; Protocol (Computers); Spacecraft Communication; Data Transfer (Computers)

63
CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS

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

20040105622 NASA Langley Research Center, Hampton, VA, USA
Aerospace Applications of Weibull and Monte Carlo Simulation with Importance Sampling
Bavuso, Salvatore J.; [1998]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Recent developments in reliability modeling and computer technology have made it practical to use the Weibull time to failure distribution to model the system reliability of complex fault-tolerant computer-based systems. These system models are becoming increasingly popular in space systems applications as a result of mounting data that support the decreasing Weibull failure distribution and the expectation of increased system reliability. This presentation introduces the new reliability modeling developments and demonstrates their application to a novel space system application. The application is a proposed guidance, navigation, and control (GN&C) system for use in a long duration manned spacecraft for a possible Mars mission. Comparisons to the constant failure rate model are presented and the ramifications of doing so are discussed.
Author
Aerospace Engineering; Monte Carlo Method; Weibull Density Functions; Sampling; Computer Systems Design

20040110436 NASA Langley Research Center, Hampton, VA, USA
Efficient Computation of Closed-loop Frequency Response for Large Order Flexible Systems
Maghami, Peiman G.; Giesy, Daniel P.; [1997]; 32 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

An efficient and robust computational scheme is given for the calculation of the frequency response function of a large order, flexible system implemented with a linear, time invariant control system. Advantage is taken of the highly structured sparsity of the system matrix of the plant based on a model of the structure using normal mode coordinates. The computational time per frequency point of the new computational scheme is a linear function of system size, a significant improvement over traditional, full-matrix techniques whose computational times per frequency point range from quadratic to cubic functions of system size. This permits the practical frequency domain analysis of systems of much larger order than by traditional, full-matrix techniques. Formulations are given for both open and closed loop loop systems. Numerical examples are presented showing the advantages of the present formulation over traditional approaches, both in speed and in accuracy. Using a model with 703 structural modes, a speed-up of almost two orders of magnitude was observed while accuracy improved by up to 5 decimal places.
Author
Feedback Control; Frequency Response; Control Systems Design; Algorithms; Flexibility

20040110504 Scripps Institution of Oceanography, La Jolla, CA
Autonomous Acoustic Source
Hodgkiss, William S.; Jun. 2002; 9 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-00-1-0377
Report No.(s): AD-A425358; No Copyright; Avail: CASI; A02, Hardcopy

An autonomous acoustic source buoy system has been designed and fabricated for use in the collection of underwater acoustic propagation data. The system consists of a surface buoy which provides battery power, signal waveform synthesis, power amplification, system control, and wireless local area network (WLAN) communications.
DTIC
Acoustic Properties; Autonomy; Buoys; Local Area Networks; Sound Generators; Sound Transmission; Underwater Acoustics

20040110682 NASA Langley Research Center, Hampton, VA, USA
A Functional Simulator of Spacecraft Resources
Liceaga, Carlos A.; Troutman, Patrick A.; [1997]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The SPAcecraft SIMulator (SPASIM) simulates the functions and resources of a spacecraft to quickly perform Phase A trade-off analyses and uncover any operational bottlenecks during any part of the mission. Failure modes and operational contingencies can be evaluated allowing optimization for a range of mission scenarios. The payloads and subsystems are simulated, using a hierarchy of graphical models, in terms of how their functions affect resources such as propellant, power, and data. Any of the inputs and outputs of the payloads and subsystems can be plotted during the simulation. Most trade-off

analyses, including those that compare current versus advanced technology, can be performed by changing values in the parameter menus. However, when a component is replaced by one with a different functional architecture, its graphical model can also be modified or replaced by drawing from a component library. SPASIM has been validated using several spacecraft designs which were at least at the Critical Design Review level. The user and programmer guide, including figures, is available on line as a hyper text document. This is an easy-to-use and expand tool which is based on MATLAB and SIMULINK. It runs on SGI workstations and PCs under Windows 95 or NT.
Author
Simulators; Computerized Simulation; Spacecraft Performance; Systems Engineering; Computer Systems Programs

20040110806 NASA Langley Research Center, Hampton, VA, USA
Architecting a Simulation Framework for Model Rehosting
Madden, Michael M.; [2004]; 15 pp.; In English; AIAA Modeling and Simulation Technologies Conference, 16-19 Aug. 2004, Providence, RI, USA
Report No.(s): AIAA Paper 2004-4924; No Copyright; Avail: CASI; A03, Hardcopy

The utility of vehicle math models extends beyond human-in-the-loop simulation. It is desirable to deploy a given model across a multitude of applications that target design, analysis, and research. However, the vehicle model alone represents an incomplete simulation. One must also replicate the environment models (e.g., atmosphere, gravity, terrain) to achieve identical vehicle behavior across all applications. Environment models are increasing in complexity and represent a substantial investment to re-engineer for a new application. A software component that can be rehosted in each application is one solution to the deployment problem. The component must encapsulate both the vehicle and environment models. The component must have a well-defined interface that abstracts the bulk of the logic to operate the models. This paper examines the characteristics of a rehostable modeling component from the perspective of a human-in-the-loop simulation framework. The Langley Standard Real-Time Simulation in C++ (LaSRS++) is used as an example. LaSRS++ was recently redesigned to transform its modeling package into a rehostable component.
Author
Mathematical Models; Computerized Simulation; Architecture (Computers); Software Reuse; Aerospace Vehicles

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NUMERICAL ANALYSIS

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

20040095906 NASA Langley Research Center, Hampton, VA, USA
Numerical Study of Flow Past a Circular Cylinder Using RANS, Hybrid RANS/LES and PANS Formulations
Elmiligui, Alaa A.; Abdol-Hamid, Khaled S.; Massey, Steven J.; Pao, S. Paul; August 4, 2004; 18 pp.; In English; 22nd AIAA Applied Aerodynamics Conference and Exhibit, 16-19 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 781-10-12
Report No.(s): AIAA Paper 2004-4959; Copyright; Avail: CASI; A03, Hardcopy

Two multiscale type turbulence models are implemented in the PAB3D solver. The models are based on modifying the Reynolds Averaged Navier-Stokes (RANS) equations. The first scheme is a hybrid RANS/LES model utilizing the two-equation (k(sub epsilon)) model with a RANS/LES transition function dependent on grid spacing and the computed turbulence length scale. The second scheme is a modified version of the partially averaged Navier-Stokes (PANS) model, where the unresolved kinetic energy parameter (f(sub k)) is allowed to vary as a function of grid spacing and the turbulence length scale. Solutions from these models are compared to RANS results and experimental data for a stationary and rotating cylinder. The parameter f(sub k) varies between zero and one and has the characteristic to be equal to one in the viscous sub layer, and when the RANS turbulent viscosity becomes smaller than the LES viscosity. The formulation, usage methodology, and validation example are presented to demonstrate the enhancement of PAB3D's time-accurate and turbulence modeling capabilities. The models are compared to RANS results and experimental data for turbulent separated flows (TS) and laminar separated flows (LS) around stationary and rotating cylinders. For a stationary cylinder, the TS case is accurately simulated using the general two-equation k(sub epsilon) turbulence model (eddy-viscosity model). PAB3D accurately predicts the drag coefficient (CD), lift coefficient (CL) and the Strouhal number (St). The LS case was a challenge for the RANS computation with an eddy-viscosity turbulence model. The RANS/LES and PANS performed well and showed marked improvements over the RANS solution. The modified PANS model was the most accurate. For the rotating cylinder, the spin ratio varied from zero to one, and the PANS results were in good agreement with published experimental data. RANS/LES and PANS capture

both temporal and spatial fluctuations and produce large-scale structures that do not occur in the RANS simulation. The current results show promise for the capability of PANS in simulating unsteady and complex flow phenomena.
Author
Mathematical Models; Rotating Cylinders; Separated Flow; Turbulence Models; Turbulent Flow; Navier-Stokes Equation

20040095948 NASA Langley Research Center, Hampton, VA, USA
Geometry Modeling and Grid Generation for Design and Optimization
Samareh, Jamshid A.; [1998]; 20 pp.; In English; ICASE/LaRC/NSF/ARO Workshop on Computational Aerosciences in the 21st Century, 22-24 Apr. 1998, Hampton, VA, USA; No Copyright; Avail: CASI; A03, Hardcopy

Geometry modeling and grid generation (GMGG) have played and will continue to play an important role in computational aerosciences. During the past two decades, tremendous progress has occurred in GMGG; however, GMGG is still the biggest bottleneck to routine applications for complicated Computational Fluid Dynamics (CFD) and Computational Structures Mechanics (CSM) models for analysis, design, and optimization. We are still far from incorporating GMGG tools in a design and optimization environment for complicated configurations. It is still a challenging task to parameterize an existing model in today's Computer-Aided Design (CAD) systems, and the models created are not always good enough for automatic grid generation tools. Designers may believe their models are complete and accurate, but unseen imperfections (e.g., gaps, unwanted wiggles, free edges, slivers, and transition cracks) often cause problems in gridding for CSM and CFD. Despite many advances in grid generation, the process is still the most labor-intensive and time-consuming part of the computational aerosciences for analysis, design, and optimization. In an ideal design environment, a design engineer would use a parametric model to evaluate alternative designs effortlessly and optimize an existing design for a new set of design objectives and constraints. For this ideal environment to be realized, the GMGG tools must have the following characteristics: (1) be automated, (2) provide consistent geometry across all disciplines, (3) be parametric, and (4) provide sensitivity derivatives. This paper will review the status of GMGG for analysis, design, and optimization processes, and it will focus on some emerging ideas that will advance the GMGG toward the ideal design environment.
Author
Grid Generation (Mathematics); Geometry; Computational Fluid Dynamics; Analysis (Mathematics); Structural Analysis; Mathematical Models

20040095956 NASA Langley Research Center, Hampton, VA, USA
Fast Computation of Frequency Response of Cavity-Backed Apertures Using MBPE in Conjunction with Hybrid FEM/MoM Technique
Reddy, C. J.; Deshpande, M. D.; Cockrell, C. R.; Beck, F. B.; [2004]; 2 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

The hybrid Finite Element Method(FEM)/Method of Moments(MoM) technique has become popular over the last few years due to its flexibility to handle arbitrarily shaped objects with complex materials. One of the disadvantages of this technique, however, is the computational cost involved in obtaining solutions over a frequency range as computations are repeated for each frequency. In this paper, the application of Model Based Parameter Estimation (MBPE) method[1] with the hybrid FEM/MoM technique is presented for fast computation of frequency response of cavity-backed apertures[2,3]. In MBPE, the electric field is expanded in a rational function of two polynomials. The coefficients of the rational function are obtained using the frequency-derivatives of the integro-differential equation formed by the hybrid FEM/MoM technique. Using the rational function approximation, the electric field is calculated at different frequencies from which the frequency response is obtained.
Author
Computation; Apertures; Cavities; Finite Element Method; Parameter Identification; Frequency Response

20040100772 NASA Langley Research Center, Hampton, VA, USA
Validation of an Experimentally Derived Uncertainty Model
Lim, K. B.; Cox, D. E.; Balas, G. J.; Juang, J.-N.; [1996]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The results show that uncertainty models can be obtained directly from system identification data by using a minimum norm model validation approach. The error between the test data and an analytical nominal model is modeled as a combination of unstructured additive and structured input multiplicative uncertainty. Robust controllers which use the experimentally derived uncertainty model show significant stability and performance improvements over controllers designed with assumed

ad hoc uncertainty levels. Use of the identified uncertainty model also allowed a strong correlation between design predictions and experimental results.
Author
Mathematical Models; System Identification

20040105592 NASA Langley Research Center, Hampton, VA, USA
Numerical Study of a Continuum Sonic Jet Interacting with a Rarefield Flow
Glass, Christoper E.; [1997]; 18 pp.; In English
Report No.(s): AIAA Paper 97-2536; Copyright; Avail: CASI; A03, Hardcopy

The results of a numerical study with flow and boundary conditions based on an experiment of a continuum sonic jet interacting with rarefied flow about a sharp leading edge flat plate at zero incidence are presented. Comparisons are made between computational fluid dynamics (CFD) and direct simulation Monte Carlo (DSMC) solutions which provide an assessment of applying each technique to the flow conditions of the experiment. An analysis of the CFD results revealed a correlation between the interaction interface of the jet continuum breakdown surface and a non-dimensional parameter derived from jet and free stream flow conditions. Using the breakdown surface from the correlation, the continuum jet was uncoupled from the interaction, thus allowing an uncoupled CFD-DSMC solution to be obtained. Also, a nearest neighbor collision algorithm, similar to the subcell technique, was implemented in the DSMC solution technique. The comparison between CFD and DSMC results shows good qualitative agreement in the interaction region and good quantitative agreement elsewhere.
Author
Computational Fluid Dynamics; Computerized Simulation; Numerical Analysis; Boundary Conditions; Jet Flow

20040105594 NASA Langley Research Center, Hampton, VA, USA
On the Directional Dependence and Null Space Freedom in Uncertainty Bound Identification
Lim, K. B.; Giesy, D. P.; [1997]; 5 pp.; In English
Report No.(s): AIAA Paper 97-3460; Copyright; Avail: CASI; A01, Hardcopy

In previous work, the determination of uncertainty models via minimum norm model validation is based on a single set of input and output measurement data. Since uncertainty bounds at each frequency is directionally dependent for multivariable systems, this will lead to optimistic uncertainty levels. In addition, the design freedom in the uncertainty model has not been utilized to further reduce uncertainty levels. The above issues are addressed by formulating a min- max problem. An analytical solution to the min-max problem is given to within a generalized eigenvalue problem, thus avoiding a direct numerical approach. This result will lead to less conservative and more realistic uncertainty models for use in robust control.
Author
Eigenvalues; Mathematical Models; Formulations

20040110323 NASA Langley Research Center, Hampton, VA, USA
Fault Accommodation in Control of Flexible Systems
Maghami, Peiman G.; Sparks, Dean W., Jr.; Lim, Kyong B.; [1998]; 30 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

New synthesis techniques for the design of fault accommodating controllers for flexible systems are developed. Three robust control design strategies, static dissipative, dynamic dissipative and mu-synthesis, are used in the approach. The approach provides techniques for designing controllers that maximize, in some sense, the tolerance of the closed-loop system against faults in actuators and sensors, while guaranteeing performance robustness at a specified performance level, measured in terms of the proximity of the closed-loop poles to the imaginary axis (the degree of stability). For dissipative control designs, nonlinear programming is employed to synthesize the controllers, whereas in mu-synthesis, the traditional D-K iteration is used. To demonstrate the feasibility of the proposed techniques, they are applied to the control design of a structural model of a flexible laboratory test structure.
Author
Systems Engineering; Actuators; Control Systems Design; Flexible Bodies

20040110343 NASA Langley Research Center, Hampton, VA, USA
Estimating Logistics Support of Reusable Launch Vehicles During Conceptual Design
Morris, W. D.; White, N. H.; Davies, W. T.; Ebeling, C. E.; [1997]; 12 pp.; In English; 32nd Annual International Logistics Conferences and Exposition, 5-7 Aug. 1997, USA; Copyright; Avail: CASI; A03, Hardcopy

Methods exist to define the logistics support requirements for new aircraft concepts but are not directly applicable to new launch vehicle concepts. In order to define the support requirements and to discriminate among new technologies and processing choices for these systems, NASA Langley Research Center (LaRC) is developing new analysis methods. This paper describes several methods under development, gives their current status, and discusses the benefits and limitations associated with their use.
Author
Reusable Launch Vehicles; Aircraft Design; Numerical Analysis

20040110358 NASA Langley Research Center, Hampton, VA, USA
A Numerical Optimization Approach for Tuning Fuzzy Logic Controllers
Woodard, Stanley E.; Garg, Devendra P.; [1997]; 29 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

This paper develops a method to tune fuzzy controllers using numerical optimization. The main attribute of this approach is that it allows fuzzy logic controllers to be tuned to achieve global performance requirements. Furthermore, this approach allows design constraints to be implemented during the tuning process. The method tunes the controller by parameterizing the membership functions for error, change-in-error and control output. The resulting parameters form a design vector which is iteratively changed to minimize an objective function. The minimal objective function results in an optimal performance of the system. A spacecraft mounted science instrument line-of-sight pointing control is used to demonstrate results.
Author
Numerical Analysis; Fuzzy Systems; Controllers; Logic Design; Tuning

20040110361 NASA Langley Research Center, Hampton, VA, USA
Application of Least-Squares Adjustment Technique to Geometric Camera Calibration and Photogrammetric Flow Visualization
Chen, Fang-Jenq; [1997]; 11 pp.; In English; ISA 43rd International Instrumentation Symposium, 4-8 May 1997, Orlando, FL, USA; No Copyright; Avail: CASI; A03, Hardcopy

Flow visualization produces data in the form of two-dimensional images. If the optical components of a camera system are perfect, the transformation equations between the two-dimensional image and the three-dimensional object space are linear and easy to solve. However, real camera lenses introduce nonlinear distortions that affect the accuracy of transformation unless proper corrections are applied. An iterative least-squares adjustment algorithm is developed to solve the nonlinear transformation equations incorporated with distortion corrections. Experimental applications demonstrate that a relative precision on the order of 40,000 is achievable without tedious laboratory calibrations of the camera.
Author
Calibrating; Cameras; Flow Visualization; Least Squares Method

20040110433 NASA Langley Research Center, Hampton, VA, USA
Arc Length Based Grid Distribution For Surface and Volume Grids
Mastin, C. Wayne; [1996]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Techniques are presented for distributing grid points on parametric surfaces and in volumes according to a specified distribution of arc length. Interpolation techniques are introduced which permit a given distribution of grid points on the edges of a three-dimensional grid block to be propagated through the surface and volume grids. Examples demonstrate how these methods can be used to improve the quality of grids generated by transfinite interpolation.
Author
Grid Generation (Mathematics); Interpolation; Three Dimensional Models; Parameterization; Surface Geometry

20040110494 George Mason Univ., Fairfax, VA
A Novel Approach to Large Scale Brain Network Models: An Algorithmic Model for Place Cell Emergence With Robotic Sensor Input
Baker, John L.; Olds, James L.; Davis, Joel L.; Jun. 16, 2004; 5 pp.; In English
Contract(s)/Grant(s): N00014-00-1-0103
Report No.(s): AD-A425321; 525424; No Copyright; Avail: CASI; A01, Hardcopy

The hippocampus is a region of the brain used in spatial navigation. This report describes the current status of a project that has the objective of using a computational model of the hippocampus to design more robust navigation procedures for autonomous systems operating in natural environments. The report includes an overview of the problem, a synopsis of prior

work in this effort, items accomplished in the work period, publications and summary conclusions. The primary item addressed in this work period was the development of a biophysically realistic computational model of a hippocampal pyramidal cell, the primary information processing unit of the hippocampus.
DTIC
Algorithms; Brain; Data Processing; Hippocampus; Mathematical Models; Robotics

20040110520 Missouri Univ., Saint Louis, MO
NURBS-Wavelets for Surface Design, Analysis, Visualization, and Applications
Chui, Charles K.; Jul. 15, 2004; 7 pp.; In English
Contract(s)/Grant(s): DAAD19-00-1-0512
Report No.(s): AD-A425448; 4G315; ARO-40095.5-MA; No Copyright; Avail: CASI; A02, Hardcopy

The central theme of this research program is 'splines and wavelets,' with applications in two specific areas: signal processing and computer graphics. New mathematical theories on affine and nonstationary wavelets under the tight frame structure were developed. While the author's theory on affine wavelets is quite complete, including arbitrary matrix dilation, vanishing moment recovery, oversampling theory, and approximation duals, his theory of nonstationary wavelets is a pioneering idea that opens up a new research area in computational mathematics. In particular, since his nonstationary consideration applies to all B-splines on arbitrary nested knot sequences, his wavelet theory extends the well-established theory of spline functions, and his new spline-wavelets with minimum support extend the current powerful spline tool box and are certainly compatible with the IGES and STEPS standards for the CAD/CAM industry. In applications to signal processing, he also has developed mathematical theories on localized cosines and Gabor frames for time-frequency localization as well as balanced multi- wavelets and the new notion of ARM-lets for processing scalar- valued signals without the need of pre-processing. In computer graphics, the author has introduced a direct approach to treating extraordinary points in surface subdivisions, based on refinable bivariate splines with small supports. The 22 papers completed over the duration of the funding period can be divided into the following three categories: (1) the development of mathematical theory and methods that will have direct application to the advancement of the fields of signal processing, image analysis, and computer graphics, including NURBS and nonstationary wavelets, affine wavelets, localized cosines, Gabor frames, and multi-wavelets; (2) signal and image processing; and (3) computer-aided surface design. Research publications produced under this grant, invited addresses, and conferences are listed.
DTIC
Computer Graphics; Design Analysis; Functions (Mathematics); Image Processing; Signal Processing; Splines; Wavelet Analysis

20040110525 Massachusetts Univ., Amherst, MA
Development of an Eddy Collision Model of Turbulence
Perot, Blair; Jul. 22, 2004; 94 pp.; In English
Contract(s)/Grant(s): N00014-01-1-0483
Report No.(s): AD-A425492; No Copyright; Avail: CASI; A05, Hardcopy

Simple fluids such as gasses and liquids are the result of collisions between molecules. More complex fluids, such as granular flows and colloidal suspensions (non- Newtonian fluids), result from the more complex collision (or interaction) behaviors of their constituent particles. In this project we have demonstrated that collision rules can be constructed for large chunks of fluid material (eddies) such that the resulting collective system behaves like the mean (RANS) flow of a turbulent fluid. These collision rules are, in essence, a turbulence model. This project has demonstrated its three primary objectives. First, it has shown that modeling turbulent flow as a collection of colliding (interacting) objects (eddies) is a theoretically viable approach. Second, the project has shown that modeling turbulence in this way can be made computationally efficient and comparable to classic Reynolds stress transport (RST) models. Finally, the collisional approach to turbulence modeling has lead to some insights into turbulence and turbulence modeling that would probably not have been achieved via the traditional RST approach.
DTIC
Collisions; Eddy Currents; Turbulence; Turbulent Flow; Vortices

20040110718 NASA Langley Research Center, Hampton, VA, USA
On the Possibility of Ill-Conditioned Covariance Matrices in the First-Order Two-Step Estimator
Garrison, James L.; Axelrod, Penina; Kasdin, N. Jeremy; [1997]; 16 pp.; In English
Report No.(s): AAS-97-195; Copyright; Avail: CASI; A03, Hardcopy

The first-order two-step nonlinear estimator, when applied to a problem of orbital navigation, is found to occasionally produce first step covariance matrices with very low eigenvalues at certain trajectory points. This anomaly is the result of the linear approximation to the first step covariance propagation. The study of this anomaly begins with expressing the propagation of the first and second step covariance matrices in terms of a single matrix. This matrix is shown to have a rank equal to the difference between the number of first step states and the number of second step states. Furthermore, under some simplifying assumptions, it is found that the basis of the column space of this matrix remains fixed once the filter has removed the large initial state error. A test matrix containing the basis of this column space and the partial derivative matrix relating first and second step states is derived. This square test matrix, which has dimensions equal to the number of first step states, numerically drops rank at the same locations that the first step covariance does. It is formulated in terms of a set of constant vectors (the basis) and a matrix which can be computed from a reference trajectory (the partial derivative matrix). A simple example problem involving dynamics which are described by two states and a range measurement illustrate the cause of this anomaly and the application of the aforementioned numerical test in more detail.
Author
Ill-Conditioned Problems (Mathematics); Matrices (Mathematics)

20040110950 NASA Langley Research Center, Hampton, VA, USA
A Simplified Mesh Deformation Method Using Commercial Structural Analysis Software
Hsu, Su-Yuen; Chang, Chau-Lyan; Samareh, Jamshid; [2004]; 33 pp.; In English; 10th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, 30 Aug. - 1 Sep. 2004, Albany, NY, USA
Contract(s)/Grant(s): 23-762-40-31
Report No.(s): AIAA Paper 2004-4409; No Copyright; Avail: CASI; A03, Hardcopy

Mesh deformation in response to redefined or moving aerodynamic surface geometries is a frequently encountered task in many applications. Most existing methods are either mathematically too complex or computationally too expensive for usage in practical design and optimization. We propose a simplified mesh deformation method based on linear elastic finite element analyses that can be easily implemented by using commercially available structural analysis software. Using a prescribed displacement at the mesh boundaries, a simple structural analysis is constructed based on a spatially varying Young s modulus to move the entire mesh in accordance with the surface geometry redefinitions. A variety of surface movements, such as translation, rotation, or incremental surface reshaping that often takes place in an optimization procedure, may be handled by the present method. We describe the numerical formulation and implementation using the NASTRAN software in this paper. The use of commercial software bypasses tedious reimplementation and takes advantage of the computational efficiency offered by the vendor. A two-dimensional airfoil mesh and a three-dimensional aircraft mesh were used as test cases to demonstrate the effectiveness of the proposed method. Euler and Navier-Stokes calculations were performed for the deformed two-dimensional meshes.
Author
Finite Element Method; Deformation; Design Optimization; Structural Analysis

20040110953 NASA Langley Research Center, Hampton, VA, USA, National Inst. of Aerospace, Hampton, VA, USA
State-Dependent Riccati Equation Regulation of Systems with State and Control Nonlinearities
Beeler, Scott C.; Cox, David E., Technical Monitor; July 2004; 29 pp.; In English
Contract(s)/Grant(s): NCC1-02043; 23-762-65-AL
Report No.(s): NASA/CR-2004-213245; NIA-2004-08; No Copyright; Avail: CASI; A03, Hardcopy

The state-dependent Riccati equations (SDRE) is the basis of a technique for suboptimal feedback control of a nonlinear quadratic regulator (NQR) problem. It is an extension of the Riccati equation used for feedback control of linear problems, with the addition of nonlinearities in the state dynamics of the system resulting in a state-dependent gain matrix as the solution of the equation. In this paper several variations on the SDRE-based method will be considered for the feedback control problem with control nonlinearities. The control nonlinearities may result in complications in the numerical implementation of the control, which the different versions of the SDRE method must try to overcome. The control methods will be applied to three test problems and their resulting performance analyzed.
Author
Feedback Control; Nonlinearity; Riccati Equation; Equations of State

20040110963 College of William and Mary, Williamsburg, VA, USA
On the Use of Kronecker Operators for the Solution of Generalized Stochastic Petri Nets
Ciardo, Gianfranco; Tilgner, Marco; [1996]; 31 pp.; In English
Contract(s)/Grant(s): NAS1-19480; Copyright; Avail: CASI; A03, Hardcopy

We discuss how to describe the Markov chain underlying a generalized stochastic Petri net using Kronecker operators on smaller matrices. We extend previous approaches by allowing both an extensive type of marking-dependent behavior for the transitions and the presence of immediate synchronizations. The derivation of the results is thoroughly formalized, including the use of Kronecker operators in the treatment of the vanishing markings and the computation of impulse-based reward measures. We use our techniques to analyze a model whose solution using conventional methods would fail because of the state-space explosion. In the conclusion, we point out ideas to parallelize our approach.
Author
Markov Chains; Petri Nets

20040110964 NASA Langley Research Center, Hampton, VA, USA
Analytic Corrections to CFD Heating Predictions Accounting for Changes in Surface Catalysis, Part II
Gnoffo, Peter A.; Inger, George R.; [1996]; 12 pp.; In English
Report No.(s): AIAA Paper 96-4589; Copyright; Avail: CASI; A03, Hardcopy

A new approach for combining the insight afforded by integral boundary-layer analysis with comprehensive (but time intensive) computational fluid dynamic (CFD) flowfield solutions of the thin-layer Navier-Stokes equations is described. The approach extracts CFD derived quantities at the wall and at the boundary layer edge for inclusion in a post-processing boundary-layer analysis. It allows a designer at a work-station to address two questions, given a single CFD solution. (1) How much does the heating change for a thermal protection system (TPS) with different catalytic properties than was used in the original CFD solution? (2) How does the heating change at the interface of two different TPS materials with an abrupt change in catalytic efficiency? The answer to the second question is particularly important, because abrupt changes from low to high catalytic efficiency can lead to localized increase in heating which exceeds the usually conservative estimate provided by a fully catalytic wall assumption. Capabilities of this approach for application to Reusable Launch Vehicle (RLV) design are demonstrated. If the definition of surface catalysis is uncertain early in the design process, results show that fully catalytic wall boundary conditions provide the best baseline for CFD design points.
Author
Analytic Functions; Computational Fluid Dynamics; Heating; Catalysis; Correction

65
STATISTICS AND PROBABILITY

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

20040110528 Stanford Research Inst., Arlington, VA
Limiting of Signals in Random Noise
Jain, Pravin C.; May 1972; 9 pp.; In English
Report No.(s): AD-A425520; No Copyright; Avail: CASI; A02, Hardcopy

The effect of ideal bandpass limiting on a signal lying in narrowband Gaussian noise is analyzed. General analytic expressions for the limiter output components are derived using an integral representation for the limiter characteristic. This method allows retention of the phases of all the signals and the intermodulation products at the limiter output, which are destroyed in the characteristic- function method generally used in limiter studies. Expressions for the desired signals and intermodulation product amplitudes are obtained for the case when the limiter input consists of three angle-modulated sinusoids and noise. The analysis is extended to n modulated sinusoids plus noise, and approximate expressions for the signal, intermodulation product, and noise terms are derived. Numerical results are presented for the signal suppression and the limiter output signal amplitudes for the case of three input signals, two of equal amplitude.
DTIC
Narrowband; Random Noise; Signal to Noise Ratios

20040110703 Bureau of the Census, Washington, DC, USA
Modified Approach to Sample Selection and Variance Estimation with Probability Proportional to Size and Fixed Sample Size
Slanta, J. G.; Fagan, J. T.; Oct. 1997; 26 pp.; In English
Report No.(s): PB2004-107238; WP-97/02; No Copyright; Avail: CASI; A03, Hardcopy

This method of sample selection is a modification of Tille's (1996) method. This modification guarantees a nonnegative unbiased sample variance of the Horvitz-Thompson estimator of the total. An alternative to the unbiased sample variance is

given which greatly reduces the number of calculations with negligible increase in bias. The modified method with the alternative variance estimator could be easily applied to large populations, making Probability Proportional to Size (PPS) fixed sample size selection more feasible.
NTIS
Sampling; Variance (Statistics); Estimators; Probability Distribution Functions

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SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

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

20040105535 NASA Langley Research Center, Hampton, VA, USA
Local Analysis of Shock Capturing Using Discontinuous Galerkin Methodology
Atkins, H. L.; [1997]; 9 pp.; In English
Report No.(s): AIAA Paper 97-2032; Copyright; Avail: CASI; A02, Hardcopy

The compact form of the discontinuous Galerkin method allows for a detailed local analysis of the method in the neighborhood of the shock for a non-linear model problem. Insight gained from the analysis leads to new flux formulas that are stable and that preserve the compactness of the method. Although developed for a model equation, the flux formulas are applicable to systems such as the Euler equations. This article presents the analysis for methods with a degree up to 5. The analysis is accompanied by supporting numerical experiments using Burgers' equation and the Euler equations.
Author
Shock; Burger Equation; Nonlinearity

20040110249 NASA Langley Research Center, Hampton, VA, USA
Design of Constant Gain Dissipative Controllers for Eigensystem Assignment in Passive Systems
Maghami, Peiman G.; Gupta, Sandeep; [1998]; 32 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Partial eigensystem assignment with output feedback can lead to an unstable closed-loop system. However, output feedback with passive linear time-invariant systems, such as flexible space structures, is guaranteed to be stable if the controller is dissipative. This paper presents a novel approach for synthesis of dissipative output feedback gain matrices for assigning a selected number of closed-loop poles. Dissipativity of a gain matrix is known to be equivalent to positive semidefiniteness of the symmetric part of the matrix. A sequential procedure is presented to assign one self-conjugate pair of closed-loop eigenvalues at each step using dissipative output feedback gain matrices, while ensuring that the eigenvalues assigned in the previous steps are not disturbed. The problem of assigning one closed-loop pair is reduced to a constrained solution of a system of quadratic equations, and necessary and sufficient conditions for the existence of a solution are presented. A minimax approach is presented for determining parameters which satisfy these conditions. This method can assign as many closed-loop system poles as the number of control inputs. A numerical example of damping enhancement for a flexible structure is presented to demonstrate the approach.
Author
Feedback Control; Controllers; Dissipation; Control Systems Design

20040110395 NASA Langley Research Center, Hampton, VA, USA
A Framework for the Optimization of Discrete-Event Simulation Models
Joshi, B. D.; Unal, R.; White, N. H.; Morris, W. D.; [1996]; 7 pp.; In English; 17th ASEM National Conference, 10-12 Oct. 1996, Dallas, TX, USA
Contract(s)/Grant(s): NAS1-19858; No Copyright; Avail: CASI; A02, Hardcopy

With the growing use of computer modeling and simulation, in all aspects of engineering, the scope of traditional optimization has to be extended to include simulation models. Some unique aspects have to be addressed while optimizing via stochastic simulation models. The optimization procedure has to explicitly account for the randomness inherent in the stochastic measures predicted by the model. This paper outlines a general purpose framework for optimization of terminating discrete-event simulation models. The methodology combines a chance constraint approach for problem formulation, together with standard statistical estimation and analyses techniques. The applicability of the optimization framework is illustrated by minimizing the operation and support resources of a launch vehicle, through a simulation model.
Author
Computerized Simulation; Optimization; Mathematical Models; Genetic Algorithms; Discretization (Mathematics)

20040110464 Evidence Based Research, Inc., Vienna, VA

Analysis of Metrics Utilized in U.S. Joint Experimentation of Future C2 Concepts

Wheatley, Gary; Dec. 2003; 40 pp.; In English; Original contains color illustrations

Report No.(s): AD-A425257; No Copyright; Avail: CASI; A03, Hardcopy

The U.S. Joint Forces Command (JFCOM) has been charged to lead the transformation of the U.S. Armed Forces through development and experimentation of new command and control concepts. In particular, the Knowledge-C2 Working Group of the Concepts Division has focused on four related concepts: Adaptive Joint Command and Control (AJC2), Common Relevant Operational Picture (CROP) and the Collaborative Information Environment (CIE), Joint Interactive Planning (JIP), and Multinational Operations (MNOPS). This paper discusses these Knowledge-C2 concepts and related experiments in the U.S. JFCOM experimental campaign. It then reports on the Unified Vision 2001 Experiment (UV01) results showing how the HEAT metrics were used to develop analyses baselines and quantitative results. Finally, it discusses the future of the experimental campaign and events. (22 briefing charts)

DTIC

Command and Control; Decision Making; Military Operations; Operations Research

20040110466 Universiteit Twente, Enschede

To Overcome Challenges in Technology Development in Support of C2 through Social Learning

Stoop, Swentibold G.; Dec. 2003; 30 pp.; In English; Original contains color illustrations

Report No.(s): AD-A425262; No Copyright; Avail: CASI; A03, Hardcopy

Developing information and communication technology in support of C2 is a difficult task. The origin of this difficulty can be traced back to two key challenges: the alignment of user needs with technical capabilities, and the timely discovery and understanding of the impact those technologies have on the C2 domain. This paper focuses on successfully overcoming these challenges. It shows that the resolution of these challenges requires learning, specifically, learning about C2 user-requirements, the capabilities of technology, and how the two of them interact in the C2 user domain. After decades of research in the field of technology assessment (TA), learning and understanding the interaction of users' needs and technology has proven to be fundamental to successful technology development. Furthermore, its importance is becoming more and more recognized in the field of C2 assessment and development as well, as shown by Mandeles, Hone and Terry (1996). Based on insights from constructive technology assessment (CTA), the author has developed a model that facilitates learning in technology development. In particular it addresses the two key challenges -alignment and timely impact assessment - to the successful development of technology in support of C2. The NATO code of best practice for C2 assessment (COBP) plays an important role in this model. C2 is still a rather diffuse and complex concept. Yet, if researchers want to be successful in technology development, the articulation of C2 user-needs is crucial. The COBP provides a structure for rigorous discovery and articulation of C2 user-needs. As such it could play an important role in the successful development of technology in support of C2. (2 figures, 18 refs., 15 briefing charts)

DTIC

Command and Control; Information Systems; Sociology; Technology Assessment; User Requirements

20040110485 Defence Science Technology Lab., Portsdown West

The Code in Practice - 'Communications are the Key"

Pickburn, George A.; Dec. 2003; 40 pp.; In English; Original contains color illustrations

Report No.(s): AD-A425293; No Copyright; Avail: CASI; A03, Hardcopy

Operational research (OR) has addressed many topics and issues in its relatively short history. Most of the dark corners of corporate, industrial, and governmental competence have been illuminated by the bright light of OR. Some clients of the art have even complained at the brightness and have contrived to deflect the beam, perhaps even far enough to dazzle the decision-makers themselves. One area of particular obscurity concerns investment in information generation, handling, fusion, and dissemination, known collectively as information management. In all domains, not just the military, information systems investment has proven difficult to justify in terms relevant to the central business objectives of the enterprise being served. This paper describes how the NATO Code of Best Practice for C2 Assessment has been applied within the UK's procurement project to acquire a new generation of communications systems for UK forces, in particular the replacement of their ageing Ptarmigan formation-level land communications system, known as the Falcon Project. (4 figures, 3 refs., 29 briefing charts)

DTIC

Command and Control; Communication Networks; Computer Networks; Data Processing; Operations Research

20040110874 Defence Science and Technology Organisation, Edinburgh, Australia
Effects-based Operations: Simulations with Cellular Automata
Das, Balaram; June 2004; 56 pp.; In English
Report No.(s): DSTO-RR-0275; DODA-AR-012-980; Copyright; Avail: Other Sources

In this report I show how simulations through cellular automata can be used to answer Effects-Based Operations (EBO) related questions. Such simulations provide effective tools to investigate the two themes that lie at the heart of the EBO paradigm which are that (a) the operations be holistic -treat the adversary as a complex system with interconnected political, military, economic and social facets and (b) that the immediate and higher order effects of the actions be gauged and exploited. This report focuses on the effects of actions against an adversary. How to integrate the friendly national capabilities for a whole of government approach has not been discussed here. An Effects-Based strategy is formulated which is a minimal strategy in the sense that it provides a mode of interdiction whose cascading effects are strong enough to compel the enemy to abandon hostilities while not driving the adversary to a point where its military, and nonmilitary social systems become unstable. The parameters governing this strategy are identified and simulations conducted to elicit the parameter values that produce the desired effects.
Author
Computerized Simulation; Automata Theory; Military Operations

20040110894 NASA Langley Research Center, Hampton, VA, USA
A Surrogate Approach to the Experimental Optimization of Multielement Airfoils
Otto, John C.; Landman, Drew; Patera, Anthony T.; July 12, 1996; 12 pp.; In English; Sixth AIAA/USAF/NASA/ISSMO Symposium on Multidisciplinary Analysis and Optimization, 4-6 Sep. 1996, Belevue, WA, USA
Contract(s)/Grant(s): NAS1-19858; NAG1-1750; N00014-91-J-1889; F49620-94-1-0121; NAG1-1613
Report No.(s): AIAA Paper 96-4138; Copyright; Avail: CASI; A03, Hardcopy

The incorporation of experimental test data into the optimization process is accomplished through the use of Bayesian-validated surrogates. In the surrogate approach, a surrogate for the experiment (e.g., a response surface) serves in the optimization process. The validation step of the framework provides a qualitative assessment of the surrogate quality, and bounds the surrogate-for-experiment error on designs 'near' surrogate-predicted optimal designs. The utility of the framework is demonstrated through its application to the experimental selection of the trailing edge ap position to achieve a design lift coefficient for a three-element airfoil.
Author
Airfoils; Optimization; Mathematical Models; Algorithms; Subsonic Wind Tunnels

20040110937 NASA Langley Research Center, Hampton, VA, USA
Optimization of Operations Resources via Discrete Event Simulation Modeling
Joshi, B.; Morris, D.; White, N.; Unal, R.; [1996]; 7 pp.; In English; 6th AIAA/USAF/NASA/ISSMO Symposium on Multidisciplinary Analysis and Optimization, 4-6 Sep. 1996, Bellevue, WA, USA
Report No.(s): AIAA Paper 96-4181; Copyright; Avail: CASI; A02, Hardcopy

The resource levels required for operation and support of reusable launch vehicles are typically defined through discrete event simulation modeling. Minimizing these resources constitutes an optimization problem involving discrete variables and simulation. Conventional approaches to solve such optimization problems involving integer valued decision variables are the pattern search and statistical methods. However, in a simulation environment that is characterized by search spaces of unknown topology and stochastic measures, these optimization approaches often prove inadequate. In this paper, we have explored the applicability of genetic algorithms to the simulation domain. Genetic algorithms provide a robust search strategy that does not require continuity and differentiability of the problem domain. The genetic algorithm successfully minimized the operation and support activities for a space vehicle, through a discrete event simulation model. The practical issues associated with simulation optimization, such as stochastic variables and constraints, were also taken into consideration.
Author
Optimization; Simulation; Resource Allocation; Operations Research; Genetic Algorithms

20040110947 NASA Langley Research Center, Hampton, VA, USA
Implementation and Performance Issues in Collaborative Optimization
Braun, Robert; Gage, Peter; Kroo, Ilan; Sobieski, Ian; [1996]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Collaborative optimization is a multidisciplinary design architecture that is well-suited to large-scale multidisciplinary

optimization problems. This paper compares this approach with other architectures, examines the details of the formulation, and some aspects of its performance. A particular version of the architecture is proposed to better accommodate the occurrence of multiple feasible regions. The use of system level inequality constraints is shown to increase the convergence rate. A series of simple test problems, demonstrated to challenge related optimization architectures, is successfully solved with collaborative optimization.
Author
Multidisciplinary Design Optimization; Design Analysis

20040110951 NASA Langley Research Center, Hampton, VA, USA
Displacement Based Multilevel Structural Optimization
Sobieszezanski-Sobieski, J.; Striz, A. G.; [1996]; 5 pp.; In English
Contract(s)/Grant(s): NAG1-1820
Report No.(s): AIAA CP-4098; No Copyright; Avail: CASI; A01, Hardcopy

In the complex environment of true multidisciplinary design optimization (MDO), efficiency is one of the most desirable attributes of any approach. In the present research, a new and highly efficient methodology for the MDO subset of structural optimization is proposed and detailed, i.e., for the weight minimization of a given structure under size, strength, and displacement constraints. Specifically, finite element based multilevel optimization of structures is performed. In the system level optimization, the design variables are the coefficients of assumed polynomially based global displacement functions, and the load unbalance resulting from the solution of the global stiffness equations is minimized. In the subsystems level optimizations, the weight of each element is minimized under the action of stress constraints, with the cross sectional dimensions as design variables. The approach is expected to prove very efficient since the design task is broken down into a large number of small and efficient subtasks, each with a small number of variables, which are amenable to parallel computing.
Author
Multidisciplinary Design Optimization; Displacement; Structural Engineering; Mathematical Models

20040110968 NASA Langley Research Center, Hampton, VA, USA
Performance of NASA Equation Solvers on Computational Mechanics Applications
Storaasli, Olaf O.; [1996]; 27 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This paper describes the performance of a new family of NASA-developed equation solvers used for large-scale (i.e. 551,705 equations) structural analysis. To minimize computer time and memory, the solvers are divided by application and matrix characteristics (sparse/dense, real/complex, symmetric/nonsymmetric, size: in-core/out of core) and exploit the hardware features of current and future computers. In this paper, the equation solvers, which are written in FORTRAN, and are therefore easily transportable, are shown to be faster than specialized computer library routines utilizing assembly code. Twenty NASA structural benchmark models with NASA solver timings reside on World Wide Web with a challenge to beat them.
Author
NASA Programs; Computer Systems Programs; Computer Systems Performance; Applications Programs (Computers); Architecture (Computers); Computation

67
THEORETICAL MATHEMATICS

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

20040110476 Scripps Institution of Oceanography, La Jolla, CA
Nonlinear Signal Classification Using Dynamical Systems Theory
Kadtke, James; Jan. 2002; 11 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-99-1-0072
Report No.(s): AD-A425281; No Copyright; Avail: CASI; A03, Hardcopy

The long range goal of this project was the development of new signal processing and data classification methods based on ideas from the field of nonlinear dynamics. Specifically, nonlinear time-domain modeling methods using closed-form dynamical equations were to be formulated in a rigorous way in the framework of standard statistical signal classification

methods. The aim was to provide new algorithms and automated tools which could enhance existing Navy systems for Sonar detection and classification, and to eventually transition them to the fleet.
DTIC
Classifications; Data Processing; Dynamical Systems; Nonlinear Systems; Nonlinearity; Signal Processing; Sonar

20040110509 California Univ., Los Angeles, CA
Model Structure Identification in Three Dimensions and Observation Design in Groundwater Modeling
Yeh, William W-G.; Sun, Ne-Zheng; Jul. 23, 2004; 4 pp.; In English
Contract(s)/Grant(s): DAAD19-01-1-0510
Report No.(s): AD-A425376; ARO-41601-EV.6; No Copyright; Avail: CASI; A01, Hardcopy

The authors have developed a methodology for optimal observation network design for parameter structure identification in groundwater modeling. The design objective is to minimize experimental cost subject to data sufficiency requirement. By incorporating the data sufficiency requirement as a constraint in the optimization model, the methodology quantitatively unifies observation network design, model structure identification, and model application reliability. They use a geostatistical simulation method to generate realizations for the real parameter field according to the available prior information. For each realization, they search for the minimum cost design that satisfies the data sufficiency requirement. After solving the design problems for each of the realizations, they then analyze the overall results. In addition, the authors combine the adjoint state method with MODFLOW for calculating sensitivity coefficients. For the remainder of the project, they will explore the possibility of generalizing the adjoint method for MODFLOW. A bibliography of 11 publications is included.
DTIC
Ground Water; Hydrology Models; Low Cost; Mathematical Models; Models; Resources Management

20040110519 New York Univ., New York, NY
Optimization of Structural Topology in the High- Porosity Regime
Kohn, Robert V.; Jul. 20, 2004; 11 pp.; In English
Contract(s)/Grant(s): DAAD19-00-1-0384
Report No.(s): AD-A425439; ARO-41240.2-MA; No Copyright; Avail: CASI; A03, Hardcopy

This project explores homogenization-based design as a systematic approach to the optimization of high- porosity materials and structures. We have shown that when the goal is maximal stiffness, extremal effective behavior does not require multiscale architecture. In fact, optimal structures can be found within a simple class of closed-cell, high- porosity composites we call 'single-scale laminates.' Moreover there is a simple formula for the Hooke's law of a single- scale laminate. It reduces the task of structural optimization for minimum weight and maximal stiffness to a convex optimization specifically, a problem of semidefinite programming. The optimal structures are not in general unique - indeed, there is a high degree of degeneracy. It is natural to use simplicity and/or continuity as selection mechanisms. We have developed efficient schemes for doing so.
DTIC
Porosity; Topology

20040110717 NASA Langley Research Center, Hampton, VA, USA
Generalized Flip-Flop Input Equations Based on a Four-Valued Boolean Algebra
Tucker, Jerry H.; Tapia, Moiez A.; [1996]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A procedure is developed for obtaining generalized flip-flop input equations, and a concise method is presented for representing these equations. The procedure is based on solving a four-valued characteristic equation of the flip-flop, and can encompass flip-flops that are too complex to approach intuitively. The technique is presented using Karnaugh maps, but could easily be implemented in software.
Author
Boolean Algebra; Equations; Turing Machines

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PHYSICS (GENERAL)

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

20040095888 Office National d'Etudes et de Recherches Aerospatiales, Meudon, France
Motor Flow Instabilities - Part 1
Vuillot, F.; Casalis, G.; Jan. 2004; 39 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425256; No Copyright; Avail: CASI; A03, Hardcopy

This paper will be given in two separate talks, a first one presenting the general problem and applications to actual motors and a second talk dealing more specifically with stability theory. Solid propellant rocket motor instability has been the subject of many research works for more than 40 years and valuable reviews can be found in references 1, 2. First concerns were to understand the sometimes violent instabilities that occurred during motor firings that could lead to motor failure or destruction. The combustion mechanisms were among the first to be studied since most of the energy released in the motor chamber is due to chemical reactions linked to propellant combustion. Indeed, only a very small fraction of this energy could, if directed to few instability modes, results in abnormal strains that could lead to propellant or case failure and then to motor destruction (see 2). Instability modes can be of several types and had been classified into volume modes and acoustic modes (see 1). Only the latter will be considered here since they appeared to be the most unpredictable. In such situations, the instabilities organize themselves around chamber acoustic modes and produce acoustic resonances,
DTIC
Solid Propellant Rocket Engines; Stability

20040095918 NASA Langley Research Center, Hampton, VA, USA
Plate Scattering Visualization: Images, Near Fields, Currents, and Far Field Patterns
Shaeffer, John; Hom, Kam; [2004]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

This paper presents a case study of a simple yet robust target for demonstration of the EM visualization process. A five lambda square plate exhibits many scattering mechanisms depending on excitation angle and polarization: specular scattering, leading and trailing edge diffraction, traveling wave, and edge wave scattering. Bistatic k space radiation images, currents maps, and near scattered / total fields are examined for each of these scattering mechanisms.
Author
Scientific Visualization; Near Fields; Far Fields; Electric Current

20040100715 Stanford Linear Accelerator Center, Stanford, CA, USA
Top-Charm Associated Production in High Energy e(sup+)e(sup-) Collisions
Han, T.; Hewett, J. L.; 1998; 28 pp.; In English
Report No.(s): DE2004-9946; SLAC-PUB-7981; No Copyright; Avail: Department of Energy Information Bridge

No abstract available
Cross Sections; Luminosity

20040100718 Fermi National Accelerator Lab., Batavia, IL, USA
Measuremnet of Inter-Strand Contact Resistance in Epoxy Impregnated Nb3Sn Rutherford Cables
Ambrosio, G.; Barzi, E.; Chichili, D.; 2003; In English
Report No.(s): DE2003-816043; FERMILAB-CONF-03/290; No Copyright; Avail: National Technical Information Service (NTIS)

An apparatus for the measurement, under transverse pressure, of the inter-strand contact resistance in epoxy-impregnated Nb3Sn Rutherford cables has been recently assembled at Fermilab. Procedures have been developed to instrument and measure samples extracted from Nb3Sn coils. Samples were extracted from coils fabricated with the Wind-and-React and the React-and-Wind technology, both presently under development at Fermilab. A ceramic binder is used to improve the insulation and to simplify the fabrication of coils using the Wind-and-React technology. Synthetic oil is used to prevent sintering during the heat treatment of coils to be wound after reaction. In order to evaluate the effects of the ceramic binder and of the synthetic oil on the inter-strand resistance, measurements of samples extracted from coils were compared with measurements of cable

stacks with varying characteristics. In this paper we describe the apparatus, the sample preparation, the measurement procedure, and the results of the first series of tests.
NTIS
Measurement; Contact Resistance; Binders (Materials)

20040100720 Fermi National Accelerator Lab., Batavia, IL, USA, Brandeis Univ., Waltham, MA, USA
First Run II B Physics Results from the Tevatron
Blocker, C.; Oct. 2003; In English
Report No.(s): DE2003-816280; FERMILAB-AB-CONF-03/309-E; No Copyright; Avail: National Technical Information Service (NTIS)

The current status of Run II at the Tevatron is covered. Upgrades of both the CDF and D0 detectors are presented, along with many illustrations of the performance and potential for significant physics measurements
NTIS
Hadrons; Particle Accelerators

20040100727 Fermi National Accelerator Lab., Batavia, IL, USA
CKM Matrix and the Unitarity Trainangle
Oct. 2003; In English
Report No.(s): DE2003-815976; FERMILAB-CONF-03/295; No Copyright; Avail: National Technical Information Service (NTIS)

This report contains the results of the Workshop on the CKM Unitarity Triangle that was held at CERN on 13-16 February 2002. There had been several Workshops on B physics that concentrated on studies at e(sup+)e(sup -) machines, at the Tevatron, or at LHC separately. Here we brought together experts of different fields, both theorists and experimentalists, to study the determination of the CKM matrix from all the available data of K, D, and B physics. The analysis of LEP data for B physics is reaching its end, and one of the goals of the Workshop was to underline the results that have been achieved at LEP, SLC, and CESR. Another goal was to prepare for the transfer of responsibility for averaging B physics properties, that have developed within the LEP community, to the present main actors of these studies, from the B factory and the Tevatron experiments. The optimal way to combine the various experimental and theoretical inputs and to fit for the apex of the Unitarity Triangle has been a contentious issue. A further goal of the Workshop was to bring together the proponents of different fitting strategies, and to compare their approaches when applied to the same inputs. Since lattice QCD plays a very important role in the determination of the non-perturbative parameters needed to constrain the CKM unitarity triangle, the first Workshop was seen as an excellent opportunity to bring together lattice theorists with the aim of establishing a working group to compile averages for phenomenologically relevant quantities. Representatives from lattice collaborations around the world were invited to attend a meeting during the Workshop. A consensus was reached to set up three test working groups, collectively known as the ''CKM Lattice Working Group'', to review a number of well-studied quantities: quark masses, the kaon B-parameter, and the matrix elements relevant for neutral B-meson mixing. These proceedings are organized as a coherent document with chapters covering the domains of activity of the working groups. They deal mainly with the present determination of the CKM matrix in the Standard Model with a brief outlook on the near future. The impact of future measurements and of physics beyond the Standard Model will be developed further in forthcoming Workshops with the same title. Indeed, the workshop was conceived as the first of a series. The second one will take place on 5-9 April 2003 in Durham and will focus on the results from the B-factories.
NTIS
Quantum Chromodynamics; Mesons; Quarks

20040100731 Fermi National Accelerator Lab., Batavia, IL, USA
Top Quark and Electroweak Results from CDF
Leone, S.; 2003; In English
Report No.(s): DE2003-816868; FERMILAB-CONF-03/326-E; No Copyright; Avail: National Technical Information Service (NTIS)

In 2001 the Tevatron run II began, after a five year period of significant upgrade of the accelerator itself and of the experiments CDF and D0. After a detector commissioning run, the CDF experiment is now taking high quality data with all subsystems functional. We report in this talk the first preliminary CDF results on top quark and W/Z boson properties, based on run II data. The top quark, discovered in 1995 at the Tevatron, has proven to be a very interesting particle. Its properties

allow to perform stringent tests of the Standard Model (SM) and to search for new physics through a deviation from SM predictions. We give here some expectations of what Tevatron run II will ultimately provide to our understanding of matter.
NTIS
Quarks; Particle Accelerators

20040100748 Purdue Univ., West Lafayette, IN, USA
Analytical and Experimental Study of the Effects of Non-Condensable in a Passive Condenser System for the Advanced Boiling Water Reactor
Revankar, S. T.; Oh, S.; 2003; In English
Report No.(s): DE2003-818849; PU/NU-03-17; No Copyright; Avail: National Technical Information Service (NTIS)

The main goal of the project is to study analytically and experimentally condensation heat transfer for the passive condenser system relevant to the safety of next generation nuclear reactor such as Simplified Boiling Water Reactor (SBWR). The objectives of this three-year research project are to: (1) obtain experimental data on the phenomenon of condensation of steam in a vertical tube in the presence of non-condensable for flow conditions of PCCS, (2) develop a analytic model for the condensation phenomena in the presence of non-condensable gas for the vertical tube, and (3) assess the RELAP5 computer code against the experimental data. The project involves experiment, theoretical modeling and a thermal-hydraulic code assessment. It involves graduate and undergraduate students' participation providing them with exposure and training in advanced reactor concepts and safety systems. In this final report, main tasks performed during the project period are summarized and the selected results are presented. Detailed descriptions for the tasks and the results are presented in each yearly report.
NTIS
Condensation; Heat Transfer; Nuclear Reactors

20040100771 Stanford Linear Accelerator Center, Stanford, CA, USA
Stabilization of Sub-Millimeter Dimensions: The New Guise of the Hierarchy Problem
Arkani-Hamed, N.; Dimopoulos, S.; March-Russell, J.; 2004; 34 pp.; In English
Report No.(s): DE2004-9923; SLAC-PUB-7949; No Copyright; Avail: Department of Energy Information Bridge

A new framework for solving the hierarchy problem was recently proposed which does not rely on low energy supersymmetry or technicolor. The fundamental Planck mass is at a TeV and the observed weakness of gravity at long distances is due the existence of new sub-millimeter spatial dimensions. In this picture the standard model fields are localized to a (3+ 1)-dimensional wall or '3-brane'. The hierarchy problem becomes isomorphic to the problem of the largeness of the extra dimensions. This is in turn inextricably linked to the cosmological constant problem, suggesting the possibility of a common solution. The radii of the extra dimensions must be prevented from both expanding to too great a size, and collapsing to the fundamental Planck length TeV(sup -1). In this paper we propose a number of mechanisms addressing this question. We argue that a positive bulk cosmological constant anti-Lambda can stabilize the internal manifold against expansion, and that the value of anti-Lambda is not unstable to radiative corrections provided that the supersymmetries of string theory are broken by dynamics on our 3-brane.
NTIS
Cosmology; Hierarchies; String Theory

20040105641 NASA Langley Research Center, Hampton, VA, USA
Effects of Heat Treatment on the Magnetic Properties of Polymer-Bound Iron Particle Cores
Namkung, M.; Wincheski, B.; Bryant, R. G.; [1998]; 14 pp.; In English; 7th Joint Magnetism and Magnetic Materials Conference, 6-9 Jan. 1998, San Francisco, CA, USA; No Copyright; Avail: CASI; A03, Hardcopy

Spherical iron particles of three different size distributions, 6-10 microns in diameter, 100 mesh and 30-80 mesh, were mixed with 2.0 wt. % of soluble imide and compression molded at 300 C under 131 MPa. Post fabrication heat treatments were performed at 960 C for 6 hours resulting in a significant enhancement of the permeability in low field region for all the specimens except for the one made of 30-80 mesh particles. The rate of core loss of these specimens at a magnetic induction of 5 kG measured up to 1 kHz shows a noticeable increase after heat treatment which, along with the permeability enhancement, can be explained by the coalescence of particles forming a network of conductivity paths in the specimens. The scanning electron micrographs taken for the 6-10 micron particle specimens show no evidence of heat treatment-induced grain growth. The untreated specimens show a very weak f(sup 2) dependence of the core loss which clearly indicates a negligible

contribution from the eddy current loss. In particular, an almost perfect linearity was found in the frequency dependence of the core loss of the untreated specimen made of 100 mesh iron particles.
Author
Iron; Metal Particles; Magnetic Properties; Heat Treatment; Imides

20040110229 NASA Langley Research Center, Hampton, VA, USA
The NASA High Intensity Radiated Fields Laboratory
Williams, Reuben A.; [1997]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

High Intensity Radiated Fields (HIRF) are the result of a multitude of intentional and nonintentional electromagnetic sources that currently exists in the world. Many of today's digital systems are susceptible to electronic upset if subjected to certain electromagnetic environments (EME). Modern aerospace designers and manufacturers increasingly rely on sophisticated digital electronic systems to provide critical flight control in both military, commercial, and general aviation aircraft. In an effort to understand and emulate the undesired environment that high energy RF provides modern electronics, the Electromagnetics Research Branch (ERB) of the Flight Electronics and Technology Division (FETD) conducts research on RF and microwave measurement methods related to the understanding of HIRF. In the High Intensity Radiated Fields Laboratory, the effects of high energy radiating electromagnetic fields on avionics and electronic systems are tested and studied.
Author
NASA Programs; Avionics; Electromagnetic Fields; General Aviation Aircraft

20040110472 Dartmouth Coll., Hanover, NH
Rapid Calculation of EMI Responses of Metallic Objects and Implementation in Inversion Schemes
Paulsen, Keith D.; Nov. 2003; 12 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-02-1-0399
Report No.(s): AD-A425274; ARO-44485.3-EV; No Copyright; Avail: CASI; A03, Hardcopy

Broadband electromagnetic induction (EMI, 10's of Hz to ^ 100's of kHz) is emerging as one of the most promising technologies for discriminating subsurface unexploded ordnance (UXO) from widespread clutter. We have succeeded in performing detailed numerical simulations of EMI responses by a considerable variety of representative objects and UXO. Nonetheless, signal inversion schemes are impeded by a lack of rapid means for calculating the responses of possible target types in a great variety of depths and dispositions relative to the sensor. In this project we have developed a reduced source set (RSS) formulation of target response, which is essentially a modified and simplified method of auxiliary sources. In the RSS approach we express the same target response as would be obtained by a full-fledged, detailed, first- principles numerical solution but using only a small number of equivalent responding entities (e.g. charges, currents, surface field components, etc. We have shown that as long as the observer is at distance that is at least some significant fraction of the smallest dimension of an object of interest, the complete and the RSS responses are essentially indistinguishable.
DTIC
Ammunition; Inversions; Magnetic Induction

20040110574 Fermi National Accelerator Lab., Batavia, IL, USA, Durham Univ., UK, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Michigan State Univ., East Lansing, MI, USA
QCD/DM Working Group
Giele, W.; Glover, E. W. N.; Hinchliffe, I.; Hutson, J.; Laenen, E.; Jan. 2004; In English
Report No.(s): DE2004-820684; FERMILAB-CONF-02/410; No Copyright; Avail: National Technical Information Service (NTIS)

Quantum Chromo-Dynamics (QCD), and more generally the physics of the Standard Model (SM), enter in many ways in high energy processes at TeV Colliders, and especially in hadron colliders (the Tevatron at Fermilab and the forthcoming LHC at CERN), First of all, at hadron colliders, QCD controls the parton luminosity, which rules the production rates of any particle or system with large invariant mass and/or large transverse momentum.
NTIS
Quantum Chromodynamics; Particle Accelerators; Group Dynamics

20040110576 Wuerzburg Univ., Germany, Fermi National Accelerator Lab., Batavia, IL, USA, Brookhaven National Lab., Upton, NY, USA, Victoria Univ. of Manchester, UK

Physics Opportunities at Higgs Factories

Bloechinger, C.; Carena, M.; Ellis, J.; Fraas, H.; Franke, F.; Jan. 2004; In English

Report No.(s): DE2004-820682; FERMILAB-CONF-02/413; No Copyright; Avail: National Technical Information Service (NTIS)

We update theoretical studies of the physics opportunities presented by (mu)(sup+)(mu)(sup -) Higgs factories. Interesting measurements of the Standard Model Higgs decays into (bar b)b,(tau)(sup+)(tau)(sup -) and WW* may be possible if the Higgs mass is less than about 160 GeV, as preferred by the precision electroweak data, the mass range being extended by varying appropriately the beam energy resolution. A suitable value of the beam energy resolution would also enable the uncertainty in the b-quark mass to be minimized, facilitating measurements of parameters in the MSSM at such a first (mu)(sup+)(mu)(sup -) Higgs factory.

NTIS

Electroweak Interactions (Field Theory); Quarks

20040110578 Virginia Univ., Charlottesville, VA, USA

Flavor Changing Kaon Decays from HyperCP: Measurements of the Branching Ratios

Dukes, E. C.; Jan. 2004; In English

Report No.(s): DE2004-820678; FERMILAB-CONF-02/408; No Copyright; Avail: National Technical Information Service (NTIS)

The Fermilab HyperCP collaboration is making precision studies of charged hyperon and kaon decays, as well as searches for rare and forbidden hyperon and kaon decays. We report here on measurements of the branching ratios of the flavor-changing neutral-current decays: K(sup(+-))(yields)(pi) (sup(+-))(mu)(sup+)(mu)(sup -), and compare our results to theoretical predictions. This is the first observation of theK(sup -)(yields)(pi)(sup -)(mu)(sup+)(mu)(sup -) decay.

NTIS

Kaons; Decay; Branching (Physics)

20040110589 Cincinnati Univ., OH, USA, Columbia Univ., New York, NY, USA, Fermi National Accelerator Lab., Batavia, IL, USA

Departure from Prediction: Electroweak Physics at NuTeV

McFarland, K. S.; Zeller, G. P.; Adams, T.; Alton, A.; Avvakumov, S.; Jan. 2004; In English

Report No.(s): DE2004-820677; FERMILAB-CONF-02/407-E; No Copyright; Avail: National Technical Information Service (NTIS)

The NuTeV experiment has performed precision measurements of the ratio of neutral-current to charged-current cross-sections in high rate, high energy neutrino and antineutrino beams on a dense, primarily steel, target. The separate neutrino and anti-neutrino beams, high statistics, and improved control of other experimental systematics, allow the determination of electroweak parameters with significantly greater precision than past (nu)N scattering experiments. Our null hypothesis test of the standard model prediction measures sin(sup 2)(theta)(sub W)(sup (on shell))= 0.2277(+-) 0. 0013(stat)(+-) 0.0009(syst), a value which is 3. 0(sigma) above the prediction. We discuss possible explanations for and implications of this discrepancy.

NTIS

Antineutrinos; Neutrino Beams; Electroweak Interactions (Field Theory)

20040110598 Fermi National Accelerator Lab., Batavia, IL, USA

Neutrino Factory Designs and R&

Geer, S.; Jan. 2004; In English

Report No.(s): DE2004-820643; FERMILAB-CONF-02/402; No Copyright; Avail: National Technical Information Service (NTIS)

The development of a very intense muon source capable of producing a millimole of muons per year would enable a Neutrino Factory(1), and perhaps eventually a Muon Collider(2), to be built. In the last two years Neutrino Factory physics studies(3) have mapped out an exciting Neutrino Factory physics program. In addition, Neutrino Factory feasibility studies(4-6) have yielded designs that appear to be 'realistic' provided the performance parameters for the critical components can be achieved. Some of the key components will need a vigorous R&D program to meet the requirements. Neutrino Factory

R&D activities in Europe(7), Japan(6,8), and the US(9) have resulted in three promising variants of the basic Neutrino Factory design.
NTIS
Neutrinos; Muons

20040110602 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Lawrence Livermore National Lab., Livermore, CA
Progress in the Study of Mesh Refinement for Particle-In-Cell Plasma Simulations and its Application to Heavy Ion Fusion
Vay, J. L.; Friedman, A.; Grote, D. P.; 2003; In English
Report No.(s): DE2004-820653; No Copyright; Avail: National Technical Information Service (NTIS)

The numerical simulation of the driving beams in a heavy ion fusion power plant is a challenging task, and, despite rapid progress in computer power, one must consider the use of the most advanced numerical techniques. One of the difficulties of these simulations resides in the disparity of scales in time and in space which must be resolved. When these disparities are in distinctive zones of the simulation region, a method which has proven to be effective in other areas (e.g. fluid dynamics simulations) is the Adaptive-Mesh-Refinement (AMR) technique. We follow in this article the progress accomplished in the last few months in the merging of the AMR technique with Particle-In-Cell (PIC) method. This includes a detailed modeling of the Lampel-Tiefenback solution for the one-dimensional diode using novel techniques to suppress undesirable numerical oscillations and an AMR patch to follow the head of the particle distribution. We also report new results concerning the modeling of ion sources using the axisymmetricWARPRZ-AMR prototype showing the utility of an AMR patch resolving the emitter vicinity and the beam edge.
NTIS
Plasmas (Physics); Simulation; Heavy Ions; Fusion

20040110603 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Mission Research Corp., Albuquerque, NM, USA, Princeton Univ., NJ, Lawrence Livermore National Lab., Livermore, CA
Results on Intense Beam Focusing and Neutralization from the Neutralized Beam Experiment
Roy, P. K.; Yu, S. S.; Eylon, S.; Henestroza, E.; Anders, A.; 2003; In English
Report No.(s): DE2004-820270; No Copyright; Avail: National Technical Information Service (NTIS)

We have demonstrated experimental techniques to provide active neutralization for space-charge dominated beams as well as to prevent uncontrolled ion beam neutralization by stray electrons. Neutralization is provided by a localized plasma injected from a cathode arc source. Unwanted secondary electrons produced at the wall by halo particle impact are suppressed using a radial mesh liner that is positively biased inside a beam drift tube. We present measurements of current transmission, beam spot size as a function of axial position, beam energy and plasma source conditions. Detailed comparisons with theory are also presented.
NTIS
Ion Beams; Beam Neutralization; Electrons

20040110609 Fermi National Accelerator Lab., Batavia, IL, USA, Illinois Univ. at Urbana-Champaign, Urbana, IL, USA, Indiana Univ. of Pennsylvania, Indiana, PA, USA
Charmonium with Three Flavors of Dynamical Quarks
2003; In English
Report No.(s): DE2003-820514; FERMILAB-CONF-02/390-T; No Copyright; Avail: National Technical Information Service (NTIS)

We present a calculation of the charmonium spectrum with three flavors of dynamical staggered quarks from gauge configurations that were generated by the MILC collaboration. We use the Fermilab action for the valence charm quarks. Our calculation of the spin-averaged 1P-1S and 2S-1S splittings yields a determination of the strong coupling, with(alpha)(sub(ovr MS))(M(sub Z))= 0.119(4).
NTIS
Charm (Particle Physics); Quarks; Computation

20040110614 Fermi National Accelerator Lab., Batavia, IL, USA
First Observation of Doubly Charmed Baryons
2003; In English
Report No.(s): DE2003-815205; FERMILAB-CONF-02/380-E; No Copyright; Avail: National Technical Information Service (NTIS)

The SELEX experiment (E781) at Fermilab has observed two statistically compelling high mass states near 3.6 GeV/c(sup 2), decaying to(Lambda)(sub c)(sup+) K(sup -)(pi)(sup+) and(Lambda)(sub c)(sup+)K(sup -)(pi)sup+(pi)(sup+). These final states are Cabibbo-allowed decay modes of doubly charmed baryons(Xi)(sub cc)(sup+) and(Xi)(sub cc)(sup++), respectively. The masses are in the range expected from theoretical considerations, but the spectroscopy is surprising. SELEX also has weaker preliminary evidence for a state near 3.8 GeV/c(sup 2), a high mass state decaying to(Lambda)(sub c)(sup+) K(sup -)(pi)(sup+)(pi)(sup+), possibly an excited(Xi)(sub cc)(sup++) (ccu*). Data are presented and discussed.
NTIS
Charm (Particle Physics); Baryons

20040110626 Princeton Univ., NJ
Inverse Bremsstrahlung Stabilization of Noise in the Generation of Ultra-Short Intense Pulses by Backward Raman Amplification
Berger, R. L.; Clark, D. S.; Solodov, A.; Valeo, E. J.; Nov. 2003; In English
Report No.(s): DE2004-820122; PPPL-3898; No Copyright; Avail: National Technical Information Service (NTIS)

Inverse bremsstrahlung absorption of the pump laser beam in a backward Raman amplifier over the round-trip light transit time through the sub-critical density plasma can more than double the electron temperature of the plasma and produce time-varying axial temperature gradients. The resulting increased Landau damping of the plasma wave and detuning of the resonance can act to stabilize the pump against unwanted amplification of Langmuir noise without disrupting nonlinear amplification of the femtosecond seed pulse. Because the heating rate increases with the charge state Z, only low-Z plasmas (hydrogen, helium, or helium-hydrogen mixtures) will maintain a low enough temperature for efficient operation.
NTIS
Bremsstrahlung; Amplification; Electron Energy

20040110661 Lawrence Livermore National Lab., Livermore, CA
Nanoscale Bio-Molecular Control Using EC-OWLS
Bearinger, J. P.; Voeroes, J.; Hubbell, J. A.; Textor, M.; Nov. 20, 2002; 12 pp.; In English
Report No.(s): DE2004-15007475; UCRL-JC-150976; No Copyright; Avail: Department of Energy Information Bridge

A recently developed technique termed 'Electrochemical Optical Waveguide Lightmode Spectroscopy' (EC-OWLS) combines evanescent-field optical sensing with electrochemical control of surface adsorption processes. Initial EC-OWLS investigations efficiently monitored molecular surface adsorption and layer thickness changes of an adsorbed polymer layer examined in situ as a function of potential applied to a waveguide1. A layer of indium tin oxide (ITO) served as both a high refractive index waveguide for optical sensing, and a conductive electrode; an electrochemical flow-through fluid cell incorporated working, reference and counter electrodes. Poly(L-lysine)- grafted-poly(ethylene glycol) (PLL-g-PEG) served as a model, polycation adsorbate. Results indicate that adsorption and desorption of PLL-g-PEG from aqueous buffer are a function of applied potential, and that binding events subsequent to PLL-g-PEG functionalization are dependent on reorganization in the molecular adlayer.
NTIS
Optical Waveguides; Control Surfaces; Surface Layers

20040110664 Lawrence Livermore National Lab., Livermore, CA
Development of Solid State NMR Methods for the Structural Characterisation of Membrane Proteins: Applications to Understand Multiple Sclerosis
Cosman, M.; Tran, A. T.; Ulloa, J.; Maxwell, R. S.; Mar. 04, 2003; 38 pp.; In English
Report No.(s): DE2004-15007469; UCRL-ID-151943; No Copyright; Avail: Department of Energy Information Bridge

Multiple sclerosis (MS) is a relapsing-remitting disorder of the central nervous system that results in the loss of the myelin sheaths insulating nerve fibers (axons). Strong evidence suggests that MS is an autoimmune disease mediated by T-cell and antibody responses against myelin antigens. Myelin oligodendrocyte glycoprotein (MOG) is a 26 kD to 28 kD an integral membrane protein of the central nervous system implicated as a target for autoaggressive antibodies in MS. To date, the

conformation of MOG in association with the myelin membrane is unknown and the exact nature of the interactions between this protein and disease-inducing immune responses have not been determined. Since membrane associated proteins are typically characterized by decreased correlation times, solution state NMR methodologies are often impracticable. Membrane proteins are also often difficult to crystallize for X-ray diffraction studies, Consequently, there is an urgent need to develop new structure characterization tools for this important class of biomolecules. The research described here overviews the initial stages of our effort to develop an integrated, NMR based approach to structural studies of MOG over the many structural domains it is postulated to posess. The structural knowledge gained about this important MS antigen in its native environment will contribute significantly to our understanding of its function in vivo. This project will also aid in the development of therapeutics to inhibit the antigen/antibody interaction and thus prevent demyelination in MS patients.
NTIS
Physiological Responses; Antibodies; Biochemistry; Central Nervous System

20040110665 Lawrence Livermore National Lab., Livermore, CA
Effects of an External Perturbation on a Cylindrical Spheromak
Terry, M. R.; May 13, 2002; 12 pp.; In English
Report No.(s): DE2004-15007468; UCRL-ID-149586; No Copyright; Avail: Department of Energy Information Bridge
In experiments like the spheromak, it becomes interesting to investigate the quality of the magnetic flux surfaces in the device. One method of doing so is to impose an external perturbation. If the magnetic field without perturbation is tangled and no flux surfaces exist, then the perturbation will have little effect. However, if the field has well defined flux surfaces, the field should react strongly to a perturbation. Magnetic islands should form and potentially cause a degradation of the plasma This paper will assume the second case of good behavior and closed surfaces and will attempt to describe the effects of an external perturbation.
NTIS
Cylindrical Bodies; Magnetic Flux; Degradation

20040110672 Lawrence Livermore National Lab., Livermore, CA
Hydrologic Resources Management Program and Underground Test Area Project. FY 2001-2002 Progress Report
Rose, T. P.; Kersting, A. B.; Harris, L. J.; Hudson, G. B.; Smith, D. K.; Aug. 15, 2003; In English
Report No.(s): DE2004-15007318; UCRL-ID-154357; No Copyright; Avail: National Technical Information Service (NTIS)
This report contains highlights of FY 2001 and 2002 technical studies conducted by the Analytical and Nuclear Chemistry Division (ANCD) at Lawrence Livermore National Laboratory (LLNL) in support of the Hydrologic Resources Management Program (HRMP) and the Underground Test Area (UGTA) Project.
NTIS
Resources Management; Hydrology

20040110680 Lawrence Livermore National Lab., Livermore, CA
X-Ray Absorption and Soft X-Ray Fluorescence Analysis of KDP Optics
Nelson, A. J.; Van Buuren, T.; Miller, E.; Land, T. A.; Bostedt, C.; Aug. 09, 2000; In English
Report No.(s): DE2004-15007268; UCRL-JC-138950; No Copyright; Avail: National Technical Information Service (NTIS)
Potassium Dihydrogen Phosphate (KDP) is a non-linear optical material used for laser frequency conversion and optical switches. Unfortunately, when KDP crystals are coated with a porous silica anti-reflection coating and then exposed to ambient humidity, they develop dissolution pits. Previous investigations have shown that thermal annealing renders KDP optics less susceptible to pitting suggesting that a modification of surface chemistry has occurred. X-ray absorption and fluorescence were used to characterize changes in the composition and structure of KDP optics as a function of process parameters. KDP native crystals were also analyzed to provide a standard basis for interpretation. Surface sensitive total electron yield and bulk sensitive fluorescence yield from the K 2p, P 2p (L(sub 2,3)-edge) and O 1s (K-edge) absorption edges were measured at each process step. Soft X-ray fluorescence was also used to observe changes associated with spectral differences noted in the absorption measurements. Results indicate that annealing at 160 C dehydrates the surface of KDP resulting in a metaphosphate surface composition with K:P:O= 1:1:3.
NTIS
Potassium Phosphates; Surface Layers; Surface Reactions; Thermal Energy

20040110702 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Lawrence Livermore National Lab., Livermore, CA

Implementations of Mesh Refinement Schemes for Particle-In-Cell Plasma Simulations

Vay, J. L.; Colella, P.; Friedman, A.; Grote, D. P.; McCorquodale, P.; 2003; In English

Report No.(s): DE2004-820787; No Copyright; Avail: National Technical Information Service (NTIS)

Plasma simulations are often rendered challenging by the disparity of scales in time and in space which must be resolved. When these disparities are in distinctive zones of the simulation region, a method which has proven to be effective in other areas (e.g. fluid dynamics simulations) is the mesh refinement technique. We briefly discuss the challenges posed by coupling this technique with plasma Particle-In-Cell simulations and present two implementations in more detail, with examples.

NTIS

Fluid Dynamics; Plasmas (Physics)

20040110743 California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

Soft Hadronic Physics at RHIC

Hardtke, D.; 2004; In English

Report No.(s): DE2004-823195; No Copyright; Avail: National Technical Information Service (NTIS)

Although soft hadronic observables do not probe the early stages of a nucleus-nucleus collision directly, the data can be used to constrain the evolutionary path of the system. I review some of the experimental data from the first year of RHIC operations with Au+Au at sqrt(s)=130 GeV. This data includes particle yields, momentum spectra, and two-particle correlations. The data point to a system that develops strong radial flow and expands to roughly twice the size of the initial system before kinetic freeze-out. The data also suggest a multi-stage freeze-out, where the particle abundances are fixed at an earlier time compared to the end of elastic interactions.

NTIS

Hadrons; Atomic Collisions; Nuclear Interactions

20040110757 Pacific Northwest National Lab., Richland, WA, USA

Radiation Damage Effects in Candidate Ceramics for Plutonium Immobilization: Final Report

Strachan, D. M.; Scheele, R. D.; Icenhower, J. P.; Buck, E. C.; Kozelisky, A. E.; Feb. 2004; In English

Report No.(s): DE2004-15007189; PNNL-14588; No Copyright; Avail: National Technical Information Service (NTIS)

No abstract available

Ceramics; Radiation Damage

20040110760 Lawrence Livermore National Lab., Livermore, CA

Synthesis and Luminescent Properties of GaN and GaN-Mn Blue Nanocrystalline Thin-Film Phosphor for FED

Bondar, V. D.; Felter, T. E.; Hunt, C. E.; Kucharsky, I. Y.; CHakhovskoy, A. G.; Apr. 09, 2001; 14 pp.; In English

Report No.(s): DE2004-15005158; UCRL-JC-141306; No Copyright; Avail: Department of Energy Information Bridge

The technologies of fabrication of thin film phosphors based on gallium nitride using rf-magnetron sputtering are developed and structural properties of films are studied. Luminescence and electron spin resonance (ESR) spectra of GaN and GaN-Mn thin films have been studied. The correlation between cathodoluminescence intensity and conductivity of GaN films has been found. The nature of emission centers in GaN and GaN-Mn thin films is discussed as well as mechanism of luminescence in these films is proposed.

NTIS

Thin Films; Fabrication; Gallium Nitrides; Phosphors

20040110765 Stanford Linear Accelerator Center, Stanford, CA, USA

Can Lepton Flavor Violating Interactions Explain the Atmospheric Neutrino Problem

Bergmann, S.; Grossman, Y.; Pierce, D. M.; 2004; 20 pp.; In English

Report No.(s): DE2004-12483; SLAC-PUB-8244; No Copyright; Avail: Department of Energy Information Bridge

We investigate whether flavor changing neutrino interactions (FCNIs) can be sufficiently large to provide a viable solution to the atmospheric neutrino problem. Effective operators induced by heavy boson exchange that allow for flavor changing neutrino scattering off quarks or electrons are related by an SU(2))sub L) rotation to operators that induce anomalous tau decays. Since SU(2))sub L) violation is small for New Physics at or above the weak scale, one can use the upper bounds on lepton flavor violating tau decays or on lepton universality violation to put severe, model-independent bounds on the relevant

non-standard neutrino interactions. Also Z-induced flavor changing neutral currents, due to heavy singlet neutrinos, are too small to be relevant for the atmospheric neutrino anomaly. We conclude that the FCNI solution to the atmospheric neutrino problem is ruled out.
NTIS
Anomalies; Leptons; Neutrinos; Particle Interactions

20040110766 Stanford Linear Accelerator Center, Stanford, CA, USA
Trojan Penguins and Isospin Violation in Hadronic B Decays
Grossman, Y.; Sep. 1999; In English
Report No.(s): DE2004-12482; SLAC-PUB-8243; No Copyright; Avail: National Technical Information Service (NTIS)
Some rare hadronic decays of B mesons, such as (B(yields))pi)K, are sensitive to isospin-violating contributions from physics beyond the Standard Model. Although commonly referred to as electroweak penguins, such contributions can often arise through tree-level exchanges of heavy particles, or through strong-interaction loop diagrams. The Wilson coefficients of the corresponding electroweak penguin operators are calculated in a large class of New Physics models, and in many cases are found not to be suppressed with respect to the QCD penguin coefficients. Several tests for these effects using observables in (B (sup +/-))yields))pi)K decays are discussed, and nontrivial bounds on the couplings of the various New Physics models are derived.
NTIS
Electroweak Interactions (Field Theory); Isotopic Spin; Particle Decay; Hadrons

20040110767 Stanford Linear Accelerator Center, Stanford, CA, USA
Resonant Two-body D Decays
Gronau, M.; Aug. 1999; 12 pp.; In English
Report No.(s): DE2004-10515; SLAC-PUB-8216; No Copyright; Avail: Department of Energy Information Bridge
The contribution of a K*(1430) 0(sup+) resonance to D(sup 0)(yields) K(sup -)(pi)(sup+) is calculated by applying the soft pion theorem, and is found to be about 20% of the measured amplitude and to be larger than the(Delta)I= 3/2 component of this amplitude. We estimate a 50% contribution to the total amplitude from a higher K*(1950) resonance. This implies large deviations from factorization in D decay amplitudes, and an enhancement of D(sup 0)-(bar D)(sup 0) mixing due to SU(3) breaking.
NTIS
Factorization; Decay Rates; Resonance Charge Exchange

20040110768 Stanford Linear Accelerator Center, Stanford, CA, USA
Accelerator Physics Challenges in Future Linear Colliders
Raubenheimer, T. O.; Aug. 1999; 10 pp.; In English
Report No.(s): DE2004-10508; SLAC-PUB-8109; No Copyright; Avail: Department of Energy Information Bridge
At the present time, there are a number of future linear collider designs with a center-of-mass energy of 500 GeV or more with luminosities in excess of 10(sup -34)cm(sup -2)/s . Many of these designs are at an advanced state of development. However, to attain the high luminosity, the colliders require very small beam emittances, strong focusing, and very good stability. In this paper, some of the outstanding issues related to producing and maintaining the small beam sizes are discussed. Although the different designs are based on very different rf technologies, many of these problems are common.
NTIS
Acceleration (Physics); Radio Frequencies; Focusing; Emittance

20040110769 Stanford Linear Accelerator Center, Stanford, CA, USA
Direct Measurement of A(sub c) using Inclusive Charm Tagging at the SLD Detector
Wright, T.; Jul. 1999; In English
Report No.(s): DE2004-10117; SLAC-PUB-8199; No Copyright; Avail: National Technical Information Service (NTIS)
We report a new measurement of A(sub c) using data obtained by SLD in 1993-98. This measurement uses a vertex tag technique, where the selection of a c-hemisphere is based on the reconstructed mass of the charm hadron decay vertex. The method uses the 3D vertexing capabilities of SLD's CCD vertex detector and the small and stable SLC beams to obtain a high c-event tagging efficiency and purity of 28% and 82%, respectively. Charged kaons identified by the CRID detector and the charge of the reconstructed vertex provide an efficient quark-antiquark tag, with the analyzing power calibrated from the data.

We obtain a preliminary result of A(sub c) = 0.603(+/-) 0.028(+/-) 0. 023.
NTIS
Charge Coupled Devices; Hadrons; Kaons; Particle Decay

20040110770 Stanford Linear Accelerator Center, Stanford, CA, USA
Compton Scattering at the NLC and Large Extra Dimensions
Davoudiasl, H.; Jul. 1999; 16 pp.; In English
Report No.(s): DE2004-10115; SLAC-PUB-8197; No Copyright; Avail: Department of Energy Information Bridge

We study Compton scattering,(gamma) e(yields)(gamma)e, in the context of the recent proposal for Weak Scale Quantum Gravity (WSQG) with large extra dimensions. It is shown that, with an ultraviolet cutoff M(sub S)(approx) 1 TeV for the effective gravity theory, the cross section forthis process at the Next Linear Collider (NLC) deviates from the prediction of the Standard Model significantly. Our results suggest that, for typical proposed NLC energies and luminosities, WSQG can be tested in the range 4 TeV(approx) less or equal to M(sub S)(approx) less or equal to 16 TeV, making(gamma)e(yields)(gamma)e an important test channel.
NTIS
Compton Effect; Standard Model (Particle Physics); Mathematical Models

20040110771 Stanford Linear Accelerator Center, Stanford, CA, USA
Measurements of Z(sub O) Electroweak Couplings at SLD(1)
Mancinelli, G.; 2004; In English
Report No.(s): DE2004-10101; SLAC-PUB-8175; No Copyright; Avail: National Technical Information Service (NTIS)

In this paper we report a summary of the results of several electroweak measurements performed by the SLD experiment at the Stanford Linear Collider (SLC). Most of these results are preliminary and are based, unless otherwise indicated, on the full 1993-1998 dataset of 560,000 hadronic Z0 decays, produced with an average electron beam polarization of 73%.
NTIS
Electroweak Interactions (Field Theory); Electron Beams; Particle Decay

20040110772 Lawrence Livermore National Lab., Livermore, CA
Relativistic Electron Beam Transport and Characteristics in Solid Density Plasmas
Snavely, R. A.; King, J.; Freeman, R. R.; Hatchett, S.; Key, M. H.; Aug. 13, 2003; In English
Report No.(s): DE2004-15005063; UCRL-JC-152429; No Copyright; Avail: National Technical Information Service (NTIS)

The transport of intense relativistic beams in solid density plasma presently is actively being studied in laser laboratories around the world. The correct understanding of the transport enables further application of fast laser driven electrons to a host of interesting uses. Advanced x-ray sources, proton and ion beam generation and plasma heating in fast ignitor fusion all are owed their eventual utility to this transport. We report on measurements of relativistic transport over the whole of the transport region, via analysis of x-ray emission. Our experiments cover laser powers from Terawatt to Petawatt. Advances in transverse imaging of fluorescent k-alpha x-rays generated along the electron beam path are used to diagnose the electron emission. Additionally the spatial pattern of Bremsstrahlung x-rays provides clues into the physics of electron transport in above Alfven current limit beams. Issues regarding the electron distribution function will be discussed in light of possible electron transport anomalies. The initial experiments performed on the Nova Petawatt Laser System were those associated with determining the nature of the electrons and x-rays in this relativistic regime especially those useful for advanced radiography sources suitable for diagnostic use in dense high-Z dynamic processes or as the driver of a relativistic electron source in the Fast-Ignitor Inertial Confinement fusion concept. The development of very large arrays of thermoluminescent detectors is detailed along with their response. The characteristic pattern of x-rays and their intensity is found from detailed analysis of the TLD detector array data. Peak intensities as high as 2 Rads at 1 meter were measured with these shielded TLD arrays. An average energy yield of x-rays of 11 Joules indicates a very large fraction of 45-55% of the laser energy is absorbed into relativistic electrons. The pattern of x-ray distribution lends insight to the initial relativistic electron distribution function and subsequent transport inside solid density material. A theoretical-computational model (MPK) combining laser focal spot data with ponderomotive kinematics with Monte Carlo collisional transport is developed here, and is presented which associates the laser interaction to the observed x-ray data. There is good agreement between the MPK model and data exhibiting ponderomotive like x-rays is found. Additional agreement is had in comparison to recent electron transport experiment utilizing Cu fluorescence to map the electron flow.
NTIS
Electron Beams; Plasma Density; Plasmas (Physics)

20040110773 Stanford Linear Accelerator Center, Stanford, CA, USA
Neutrino Masses and Sneutrino Mixing in R-Parity Violating Supersymmetry
Grossman, Y.; Haber, H. H.; 2004; 14 pp.; In English
Report No.(s): DE2004-10100; SLAC-PUB-8173; No Copyright; Avail: Department of Energy Information Bridge

R-parity-violating supersymmetry with a conserved baryon number B provides a framework for particle physics with lepton number (L) violating interactions. Two important probes of the L-violating physics are neutrino masses and sneutrino-antisneutrino mass-splittings. We evaluate these quantities in the context of the most general CP-conserving, R-parity-violating B-conserving extension of the minimal supersymmetric standard model. In generic three-generation models, three sneutrino-antisneutrino mass splittings are generated at tree-level. In contrast, only one neutrino mass is generated at tree-level; the other two neutrinos acquire masses at one-loop. In many models, the dominant contribution to the radiative neutrino masses is induced by the non-zero sneutrino-antisneutrino mass splitting.
NTIS
Supersymmetry; Neutrinos

20040110774 Lawrence Livermore National Lab., Livermore, CA
Photothermal Multi-pixel Imaging Microscope
Stolz, C. J.; Chinn, D. J.; Huber, R. D.; Weinzapfel, C. L.; Wu, Z.; Dec. 01, 2003; In English
Report No.(s): DE2004-15007255; UCRL-CONF-153485; No Copyright; Avail: National Technical Information Service (NTIS)

Photothermal microscopy is a useful nondestructive tool for the identification of fluence-limiting defects in optical coatings. Traditional photothermal microscopes are single-pixel detection devices. Samples are scanned under the microscope to generate a defect map. For high-resolution images, scan times can be quite long (1 mm2 per hour). Single-pixel detection has been used traditionally because of the ease in separating the laser-induced topographical change due to defect absorption from the defect surface topography. This is accomplished by using standard chopper and lock-in amplifier techniques to remove the DC signal. Multi-pixel photothermal microscopy is now possible by utilizing an optical lock-in technique. This eliminates the lock-in amplifier and enables the use of a CCD camera with an optical lock in for each pixel. With this technique, the data acquisition speed can be increased by orders of magnitude depending on laser power, beam size, and pixel density.
NTIS
Nondestructive Tests; Fluence; Microscopy; Antireflection Coatings

20040110823 Fermi National Accelerator Lab., Batavia, IL, USA
Neutrino Factories: Physics Potential
Geer, S.; 2003; In English
Report No.(s): DE2003-820515; FERMILAB-CONF-02/394; No Copyright; Avail: National Technical Information Service (NTIS)

The physics potential of low-performance and high-performance neutrino factories is briefly reviewed.
NTIS
Industrial Plants; Neutrinos

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*.

20040100831 NASA Langley Research Center, Hampton, VA, USA
Comparison of Modal Analysis Methods Applied to a Vibro-Acoustic Test Article
Pritchard, Jocelyn; Pappa, Richard; Buehrle, Ralph; Grosveld, Ferdinand; [2001]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Modal testing of a vibro-acoustic test article referred to as the Aluminum Testbed Cylinder (ATC) has provided frequency response data for the development of validated numerical models of complex structures for interior noise prediction and control. The ATC is an all aluminum, ring and stringer stiffened cylinder, 12 feet in length and 4 feet in diameter. The cylinder was designed to represent typical aircraft construction. Modal tests were conducted for several different configurations of the

cylinder assembly under ambient and pressurized conditions. The purpose of this paper is to present results from dynamic testing of different ATC configurations using two modal analysis software methods: Eigensystem Realization Algorithm (ERA) and MTS IDEAS Polyreference method. The paper compares results from the two analysis methods as well as the results from various test configurations. The effects of pressurization on the modal characteristics are discussed.
Author
Acoustics; Aluminum; Vibration Tests; Mathematical Models; Test Stands

20040110312 NASA Langley Research Center, Hampton, VA, USA
An Analytical Comparison of the Acoustic Analogy and Kirchhoff Formulation for Moving Surfaces
Brentner, Kenneth S.; Farassat, F.; AIAA Journal; 1998; Volume 36, No. 8, pp. 1379-1386; In English; American Helicopter Society 53rd Annual Forum, 29 Apr. 1 May 1997, Virginia Beach, VA, USA; Copyright; Avail: CASI; A03, Hardcopy

The Lighthill acoustic analogy, as embodied in the Ffowcs Williams-Hawkings (FW-H) equation, is compared with the Kirchhoff formulation for moving surfaces. A comparison of the two governing equations reveals that the primary advantage of the Kirchhoff formulation (namely that nonlinear ow effects are included in the surface integration) is also available to the FW-H method if the integration surface used in the FW-H equation is not assumed to be impenetrable. The FW-H equation is analytically superior for aeroacoustics because it is based on the conservation laws of fluid mechanics rather than on the wave equation. Thus, the FW-H equation is valid even if the integration surface is in the nonlinear region. This advantage is demonstrated numerically. With the Kirchhoff approach, substantial errors can result if the integration surface is not positioned in the linear region, and these errors may be hard to identify. Finally, new metrics, based on the Sobolev norm, are introduced that may be used to compare input data for both quadrupole noise calculations and Kirchhoff noise predictions.
Author
Aeroacoustics; Fluid Mechanics; Noise Prediction

20040110355 NASA Langley Research Center, Hampton, VA, USA
A Superior Kirchhoff Method for Aeroacoustic Noise Prediction: The Ffowcs Williams-Hawkings Equation
Brentner, Kenneth S.; [1997]; 20 pp.; In English; 134th Meeting of the Acoustical Society of America, 1-5 Dec. 1997, San Diego, CA, USA; No Copyright; Avail: CASI; A03, Hardcopy

The prediction of aeroacoustic noise is important; all new aircraft must meet noise certification requirements. Local noise standards can be even more stringent. The NASA noise reduction goal is to reduce perceived noise levels by a factor of two in 10 years. The objective of this viewgraph presentation is to demonstrate the superiority of the FW-H approach over the Kirchoff method for aeroacoustics, both analytically and numerically.
Derived from text
Aeroacoustics; Noise Prediction; Aerodynamic Noise

20040110372 NASA Langley Research Center, Hampton, VA, USA
Application of the Pseudo Wigner-Ville Distribution to the Measurement of the Dispersion of Lamb Modes in Graphite/Epoxy Plates
Prosser, W. H.; Seale, M. D.; Smith, B. T.; [1997]; 6 pp.; In English; 8th International Symposium on Nondestructive Characaterization of Materials, 15-20 Jun. 1997; No Copyright; Avail: CASI; A02, Hardcopy

Acoustic waves propagate in thin plates as guided or Lamb modes. The velocities of these modes are dispersive in that they depend not only on the material elastic properties and density, but also on the frequency. Accurate characterization of Lamb wave dispersion is important in many acoustic based nondestructive evaluation techniques. It is necessary for ultrasonic measurements in thin plates to determine elastic properties and for flaw detection and localization. In acoustic emission (AE) testing, if not taken into account, highly dispersive Lamb mode propagation can lead to large errors in source location. In this study, the pseudo Wigner-Ville distribution (PWVD) was used for measurement of group velocity dispersion of Lamb waves in a unidirectional graphite/epoxy (AS4/3502) laminate. The PWVD is one of a number of transforms which provide a time-frequency representation of a digitized time series. Broad band acoustic waves were generated by a pencil lead fracture (Hsu-Neilsen source) and were detected with broad band ultrasonic transducers. The arrival times for the lowest order symmetric (S(sub 0)) and antisymmetric (A(sub 0)) Lamb modes were determined from measurements of the time at which the respective peak amplitudes occurred in the PWVD. Measurements were made at several source-to-detector distances and a least squares fit used to calculate the velocity. Results are presented for propagation along, and perpendicular to, the fiber

direction. Theoretical dispersion curves were also calculated and a comparison between theory and experiment demonstrates good agreement.
Author (revised)
Graphite-Epoxy Composites; Thin Plates; Lamb Waves

20040110379 NASA Langley Research Center, Hampton, VA, USA
Propulsion Airframe Aeroacoustics Technology Evaluation and Selection Using a Multi-Attribute Decision Making Process and Non-Deterministic Design
Burg, Cecile M.; Hill, Geoffrey A.; Brown, Sherilyn A.; Geiselhart, Karl A.; [2004]; 9 pp.; In English; 10th AIAA/ISSMO Multidisciplinary Analysis Optimization Conference, 30 Aug. - 1 Sep. 2004, Albany, NY, USA
Contract(s)/Grant(s): 23-781-10-12
Report No.(s): AIAA Paper 2004-4436; Copyright; Avail: CASI; A02, Hardcopy

The Systems Analysis Branch at NASA Langley Research Center has investigated revolutionary Propulsion Airframe Aeroacoustics (PAA) technologies and configurations for a Blended-Wing-Body (BWB) type aircraft as part of its research for NASA s Quiet Aircraft Technology (QAT) Project. Within the context of the long-term NASA goal of reducing the perceived aircraft noise level by a factor of 4 relative to 1997 state of the art, major configuration changes in the propulsion airframe integration system were explored with noise as a primary design consideration. An initial down-select and assessment of candidate PAA technologies for the BWB was performed using a Multi-Attribute Decision Making (MADM) process consisting of organized brainstorming and decision-making tools. The assessments focused on what effect the PAA technologies had on both the overall noise level of the BWB and what effect they had on other major design considerations such as weight, performance and cost. A probabilistic systems analysis of the PAA configurations that presented the best noise reductions with the least negative impact on the system was then performed. Detailed results from the MADM study and the probabilistic systems analysis will be published in the near future.
Author
Aeroacoustics; Airframes; Aircraft Noise; Design Analysis; Noise Reduction; Technology Assessment

20040110385 NASA Langley Research Center, Hampton, VA, USA
Supersonic Quadrupole Noise Theory for High-Speed Helicopter Rotors
Farassat, F.; Brentner, Kenneth S.; [1997]; 18 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

High-speed helicopter rotor impulsive noise prediction is an important problem of aeroacoustics. The deterministic quadrupoles have been shown to contribute significantly to high-speed impulsive (HSI) noise of rotors, particularly when the phenomenon of delocalization occurs. At high rotor-tip speeds, some of the quadrupole sources lie outside the sonic circle and move at supersonic speed. Brentner has given a formulation suitable for efficient prediction of quadrupole noise inside the sonic circle. In this paper, we give a simple formulation based on the acoustic analogy that is valid for both subsonic and supersonic quadrupole noise prediction. Like the formulation of Brentner, the model is exact for an observer in the far field and in the rotor plane and is approximate elsewhere. We give the full analytic derivation of this formulation in the paper. We present the method of implementation on a computer for supersonic quadrupoles using marching cubes for constructing the influence surface (Sigma surface) of an observer space- time variable (x; t). We then present several examples of noise prediction for both subsonic and supersonic quadrupoles. It is shown that in the case of transonic flow over rotor blades, the inclusion of the supersonic quadrupoles improves the prediction of the acoustic pressure signature. We show the equivalence of the new formulation to that of Brentner for subsonic quadrupoles. It is shown that the regions of high quadrupole source strength are primarily produced by the shock surface and the flow over the leading edge of the rotor. The primary role of the supersonic quadrupoles is to increase the width of a strong acoustic signal.
Author
Supersonic Speed; Quadrupoles; Noise Prediction; High Speed; Rotary Wings

20040110387 NASA Langley Research Center, Hampton, VA, USA
A Study of the Effects of Blade Shape on Rotor Noise
Jones, Henry E.; Burley, Casey L.; [1997]; 15 pp.; In English; AHS Technical Specialists' Meeting for Rotorcraft Acoustics and Aerodynamics, 28-30 Oct. 1997, Williamsburg, VA, USA; No Copyright; Avail: CASI; A03, Hardcopy

A new rotor noise prediction system called the Tiltrotor Aeroacoustic Code (TRAC) has been developed under the Short Haul (Civil Tiltrotor) program between NASA, the Army, and the U.S. helicopter industry. This system couples the comprehensive rotorcraft code CAMRAD.Mod1 with either the high resolution sectional loads code HIRES or the full

potential CFD code FPRBVI to predict unsteady blade loads, which are then input to the noise prediction program WOPWOP. In this paper, HIRES will be used to predict the blade-vortex interaction (BVI) noise trends associated with blade shape. The baseline shape selected was a 17% scale model of a contemporary design 4 bladed rotor. Measurements for this rotor were acquired in the Duits-Nederslandse Windtunnel (DNW). The code is used to predict noise for the base configuration and the results are compared to the measured data. This provides a firm foundation for investigating the BVI noise trends associated with blade shape. The shapes selected for study are based on variation of sweep and taper which reflect plausible 'passive' design concepts. Comparisons of power required, integrated noise, and aerodynamics are made and important trends are noted.
Author
Blade-Vortex Interaction; Computational Fluid Dynamics; Rotor Aerodynamics; Noise Prediction

20040110388 NASA Langley Research Center, Hampton, VA, USA
A Comparison of Measured and Predicted XV-15 Tiltrotor Surface Acoustic Pressures
Lyle, Karen H.; Burley, Casey L.; Prichard, Devon S.; [1997]; 13 pp.; In English; AHS Technical Specialists' Meeting for Rotorcraft Acoustics and Aerodynamics, 28-30 Oct. 1997, Williamsburg, VA, USA; No Copyright; Avail: CASI; A03, Hardcopy

Predicted XV-15 exterior surface acoustic pressures are compared with previously published experimental data. Surface acoustic pressure transducers were concentrated near the tip-path-plane of the rotor in airplane mode. The comparison emphasized cruise conditions which are of interest for tiltrotor interior noise - level flight for speeds ranging from 72 m/s to 113 m/s. The predictions were produced by components of the NASA Langley Tiltrotor Aeroacoustic Code (TRAC) system of computer codes. Comparisons between measurements and predictions were made in both the time and frequency domains, as well as overall sound pressure levels. In general, the predictions replicated the measured data well. Discrepancies between measurements and predictions were noted. Some of the discrepancies were due to poor correlation of the measured data with the rotor tach signal. In other cases limitations of the predictive methodology have been indicated.
Author
Xv-15 Aircraft; Aeroacoustics; Noise Prediction (Aircraft); Sound Pressure; Rotor Aerodynamics

20040110429 NASA Langley Research Center, Hampton, VA, USA
Advanced AE Techniques in Composite Materials Research
Prosser, William H.; Journal of Acoustic Emission; 1996; Volume 14, No. 3-4, pp. S1-S-11; In English; Copyright; Avail: CASI; A03, Hardcopy

Advanced, waveform based acoustic emission (AE) techniques have been successfully used to evaluate damage mechanisms in laboratory testing of composite coupons. An example is presented in which the initiation of transverse matrix cracking was monitored. In these tests, broad band, high fidelity acoustic sensors were used to detect signals which were then digitized and stored for analysis. Analysis techniques were based on plate mode wave propagation characteristics. This approach, more recently referred to as Modal AE, provides an enhanced capability to discriminate and eliminate noise signals from those generated by damage mechanisms. This technique also allows much more precise source location than conventional, threshold crossing arrival time determination techniques. To apply Modal AE concepts to the interpretation of AE on larger composite specimens or structures, the effects of modal wave propagation over larger distances and through structural complexities must be well characterized and understood. To demonstrate these effects, measurements of the far field, peak amplitude attenuation of the extensional and flexural plate mode components of broad band simulated AE signals in large composite panels are discussed. These measurements demonstrated that the flexural mode attenuation is dominated by dispersion effects. Thus, it is significantly affected by the thickness of the composite plate. Furthermore, the flexural mode attenuation can be significantly larger than that of the extensional mode even though its peak amplitude consists of much lower frequency components.
Author
Acoustic Emission; Composite Materials; Waveforms; Wave Propagation

20040110470 Scripps Institution of Oceanography, La Jolla, CA
Acoustic Emissions of Bubble Clouds in Salt Water
Berger, Thomas; Jun. 2003; 7 pp.; In English
Contract(s)/Grant(s): N00014-00-1-0050
Report No.(s): AD-A425270; No Copyright; Avail: CASI; A02, Hardcopy

Experiments were performed to investigate the sound from an axi-symmetric, conical bubble plume formed by a

continuous, vertical water jet as it penetrates the surface of a pool of water.
DTIC
Acoustic Emission; Bubbles; Water

20040110471 Scripps Institution of Oceanography, La Jolla, CA
DURIP - Mid-Frequency Source-Receive Array
Hodgkiss, William S.; Jun. 2003; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-01-1-0799
Report No.(s): AD-A425272; No Copyright; Avail: CASI; A03, Hardcopy

A mid-frequency (^85O Hz) source-receive array has been fabricated for use in demonstrating enhanced operation of offboard active surveillance systems using phase conjugation (time reversal mirror") concepts. The source-receive array and its companion surface buoy operate in an autonomous fashion thus facilitating single ship operations for carrying out experimental work. The equipment needed for system fabrication was supported by this DURIP. The personnel support for system fabrication was provided separately under grant NOOOl4-O1-1- 0794.
DTIC
Buoys; Frequencies; Phase Conjugation; Sonar

20040110475 Scripps Institution of Oceanography, La Jolla, CA
Adaptive Beach Monitoring
Kuperman, William A.; Jan. 2002; 10 pp.; In English
Contract(s)/Grant(s): N00014-96-1-0852
Report No.(s): AD-A425280; No Copyright; Avail: CASI; A02, Hardcopy

The long-term goal of the Marine Physical Laboratory's Adaptive Beach Monitoring (ABM) program is to determine the capabilities of small on-shore and off-shore seismoacoustic arrays along with directional wave and current sensors to provide the amphibious force commander with a covert monitoring capability of shore-based as well as near- shore enemy forces, near-shore current and wave dynamics, and beach surf conditions.
DTIC
Acoustics; Adaptation; Oceans; Seismology; Signal Processing; Water Waves

20040110479 Scripps Institution of Oceanography, La Jolla, CA
The Effects of Ambient Noise Field on the Behavior of Baleen Whales - Pilot Program
Stokes, M. D.; Aug. 2003; 23 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-02-1-0895
Report No.(s): AD-A425285; No Copyright; Avail: CASI; A03, Hardcopy

A program of fieldwork was carried out at Peregian Beach, Australia, between 13 September and 26 October. The work was a Pilot Study for a Main Study in 2003 and 2004 concerning the setting to work of a system for passive acoustic and visual tracking of whales, as well as collecting acoustic and remotely observed behavioral data to provide the baseline information of the undisturbed 'normal' behavior of the whales during migration along the coast of Australia.
DTIC
Ambience; Noise (Sound); Whales

20040110505 Scripps Institution of Oceanography, La Jolla, CA
Use of Marine Mammal Vocalizations for Tracking 3- D and Geophysical Inversions
Kuperman, W.; Dec. 2000; 29 pp.; In English
Contract(s)/Grant(s): N00014-97-1-0593
Report No.(s): AD-A425359; No Copyright; Avail: CASI; A03, Hardcopy

Recordings of marine mammal vocalizations collected by large aperture hydrophone arrays in Summer, 1996, will be used to determine anatomical and behavioural information on the vocalizing animal. Recently developed advanced signal processing techniques in the fields of human speech processing and underwater acoustics will be modified and applied for this

purpose. This information provides valuable input into studies of the effects of manmade sounds on marine mammals and on the use of underwater acoustic data in marine mammal census surveys.
DTIC
Acoustic Measurement; Animals; Arrays; Geophysics; Inversions; Mammals; Marine Biology; Marine Mammals; Signal Processing; Underwater Acoustics

20040110507 Scripps Institution of Oceanography, La Jolla, CA
Acoustic Properties of Bubble Plumes
Melville, W. K.; Sep. 2000; 8 pp.; In English
Contract(s)/Grant(s): N00014-93-1-0081
Report No.(s): AD-A425367; No Copyright; Avail: CASI; A02, Hardcopy

The scientific goal of this work was to better understand the process of air entrainment by breaking waves and its influence on the sound speed field in the surface layers of the ocean. The program had two principal components: (a) The development and deployment of an autonomous sound speed profiling buoy, its deployment, and the analysis of the collected data. (b) The development of models for the evolution of the bubble size distribution. The initial development of the program focused on participation in the Acoustic Surface Reverberation Experiment (ASREX) in the N. Atlantic in the winter of 1993-94. Other components of the program included the analysis of ambient sound and environmental data collected during SWADE and NOBS, and the completion of doctoral thesis research and publications at MIT.
DTIC
Acoustic Properties; Air Flow; Bubbles; Entrainment; Plumes

20040110522 Washington Univ., Seattle, WA
Sound Speed and Attenuation Measurements in Unconsolidated Glass Bead Sediments Saturated With Viscous Pore Fluids
Hefner, Brian T.; Williams, Kevin L.; Jun. 28, 2004; 29 pp.; In English
Contract(s)/Grant(s): N00014-02-1-0336
Report No.(s): AD-A425469; No Copyright; Avail: CASI; A03, Hardcopy

During the sediment acoustics experiment (SAX99) independent sound speed and attenuation measurements were made in a well-characterized sandy sediment. These measurements covered a broad frequency range that made it possible to test both Biot theory and Buckingham's more recent grain-to-grain attenuation model. Biot theory was able to model sound speed well but was unable to predict attenuation measured above 50 kHz. A series of measurements was made in the laboratory to test the hypothesis that this modeling deviation was due to scattering within the sediment. The measured attenuation in the glass bead sediments exhibited the same frequency dependence observed in the SAX99 data, indicating that scattering is not the relevant attenuation mechanism. A sediment model is proposed which is a hybrid of the Biot and Buckingham theories. This hybrid model is able to predict both attenuation and sound speed in the SAX99 sediment and in the laboratory sediments. The implications of the success of the hybrid model are discussed.
DTIC
Acoustic Attenuation; Acoustic Velocity; Beads; Glass; Sediments; Viscous Fluids

20040110666 Lawrence Livermore National Lab., Livermore, CA
Detection of Materials of Interest to Non Proliferation: A Novel Approach
Ze, F.; Tittmann, B. R.; Lenahan, P. M.; Apr. 2002; 24 pp.; In English
Report No.(s): DE2004-15007466; UCRL-JC-147952; No Copyright; Avail: Department of Energy Information Bridge

We propose the development of a novel detector that can locate and identify materials of interest to Nuclear Arms Non Proliferation. The device will combine nuclear acoustic resonance (NAR) with superconducting quantum interference device (SQUID) widely used in nuclear magnetic resonance (NMR), geophysics, nondestructive evaluations, and biomagnetism, to name only few. NAR works like NMR. Thus resonant absorption (of applied ultrasonic energy) by a nuclear spin system occurs when the ultrasonic frequency is equal to the appropriate frequency separations between the magnetic nuclear energy levels. Ultrasonic energy couples to the nuclear spin system via spin-phonon interaction. The resulting nuclear acoustic resonance can be detected via the changes in (a) ultrasonic attenuation, (b) ultrasonic velocity, (c) material magnetization, (d) or nuclear magnetic susceptibility, all of which carries intrinsic and unique signatures of the material under investigation. The devices sensitivity and penetration depth (into metals) will be enhanced by incorporating SQUID technology into the design.

We will present the details of interaction physics and outline a plan of action needed to successfully transform the concepts into a practical detector.
NTIS
Acoustic Resonance; Energy Levels; Magnetic Permeability; Nuclear Magnetic Resonance

20040110859 Lockheed Martin Engineering and Sciences Co., Hampton, VA, USA
Numerical Comparison of Active Acoustic and Structural Noise Control in a Stiffened Double Wall Cylinder
Grosveld, Ferdinand W.; [1996]; 12 pp.; In English
Contract(s)/Grant(s): NAS1-19000; Copyright; Avail: CASI; A03, Hardcopy

The active acoustic and structural noise control characteristics of a double wall cylinder with and without ring stiffeners were numerically evaluated. An exterior monopole was assumed to acoustically excite the outside of the double wall cylinder at an acoustic cavity resonance frequency. Structural modal vibration properties of the inner and outer shells were analyzed by post-processing the results from a finite element analysis. A boundary element approach was used to calculate the acoustic cavity response and the coupled structural-acoustic interaction. In the frequency region of interest, below 500 Hz, all structural resonant modes were found to be acoustically slow and the nonresonant modal response to be dominant. Active sound transmission control was achieved by control forces applied to the inner or outer shell, or acoustic control monopoles placed just outside the inner or outer shell. A least mean square technique was used to minimize the interior sound pressures at the nodes of a data recovery mesh. Results showed that single acoustic control monopoles placed just outside the inner or outer shells resulted in better sound transmission control than six distributed point forces applied to either one of the shells. Adding stiffeners to the double wall structure constrained the modal vibrations of the shells, making the double wall stiffer with associated higher modal frequencies. Active noise control obtained for the stiffened double wall configurations was less than for the unstiffened cylinder. In all cases, the acoustic control monopoles controlled the sound transmission into the interior better than the structural control forces.
Author
Circular Cylinders; Acoustics; Walls; Active Control; Structural Vibration; Rigid Structures

20040110862 NASA Langley Research Center, Hampton, VA, USA
Sound Transmission through Cylindrical Shell Structures Excited by Boundary Layer Pressure Fluctuations
Tang, Yvette Y.; Silcox, Richard J.; Robinson, Jay H.; [1996]; 11 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This paper examines sound transmission into two concentric cylindrical sandwich shells subject to turbulent flow on the exterior surface of the outer shell. The interior of the shells is filled with fluid medium and there is an airgap between the shells in the annular space. The description of the pressure field is based on the cross-spectral density formulation of Corcos, Maestrello, and Efimtsov models of the turbulent boundary layer. The classical thin shell theory and the first-order shear deformation theory are applied for the inner and outer shells, respectively. Modal expansion and the Galerkin approach are used to obtain closed-form solutions for the shell displacements and the radiation and transmission pressures in the cavities including both the annular space and the interior. The average spectral density of the structural responses and the transmitted interior pressures are expressed explicitly in terms of the summation of the cross-spectral density of generalized force induced by the boundary layer turbulence. The effects of acoustic and hydrodynamic coincidences on the spectral density are observed. Numerical examples are presented to illustrate the method for both subsonic and supersonic flows.
Author
Cylindrical Shells; Pressure Oscillations; Shell Theory; Sound Transmission; Mathematical Models; Turbulent Boundary Layer; Sandwich Structures

20040110869 NASA Glenn Research Center, Cleveland, OH, USA
Far-Field Acoustic Characteristics of Multiple Blade-Vane Configurations for a High Tip Speed Fan, Supplement
Woodward, Richard P.; May 2004; In English
Report No.(s): NASA/TM-2004-213093/SUPPL; No Copyright; Avail: CASI; C01, CD-ROM

The contents of this CD-ROM include: 1) Aero Data; 2) Data Documents (Daily Acoustic Data Logs, Test Documentation, Test Photos); 3) EPNL Data (All Core Tones Removed, All Core Tones Removed and Various Bypass Tones, Core BPF Tone Removed, Core Tones Present); 4) Far-Field Acoustic Data, 5) High Speed Fan Reports; 6) Sound Power Levels (As-Measured PWL, Lossless PWL).
CASI
Fan Blades; Acoustic Properties; Acoustic Measurement

20040110946 NASA Langley Research Center, Hampton, VA, USA
Experimental Robust Control of Structural Acoustic Radiation
Cox, David E.; Gibbs, Gary P.; Clark, Robert L.; Vipperman, Jeffrey S.; [1998]; 9 pp.; In English
Report No.(s): AIAA Paper 98-2089; Copyright; Avail: CASI; A02, Hardcopy

This work addresses the design and application of robust controllers for structural acoustic control. Both simulation and experimental results are presented. H(infinity) and mu-synthesis design methods were used to design feedback controllers which minimize power radiated from a panel while avoiding instability due to unmodeled dynamics. Specifically, high order structural modes which couple strongly to the actuator-sensor path were poorly modeled. This model error was analytically bounded with an uncertainty model, which allowed controllers to be designed without artificial limits on control effort. It is found that robust control methods provide the control designer with physically meaningful parameters with which to tune control designs and can be very useful in determining limits of performance. Experimental results also showed, however, poor robustness properties for control designs with ad-hoc uncertainty models. The importance of quantifying and bounding model errors is discussed.
Author
Sound Waves; Acoustics; Robustness (Mathematics); Control Systems Design; Mathematical Models; Panels; Mechanical Engineering

20040110957 NASA Langley Research Center, Hampton, VA, USA
Applications of Response Surface-Based Methods to Noise Analysis in the Conceptual Design of Revolutionary Aircraft
Hill, Geoffrey A.; Olson, Erik D.; June 22, 2004; 12 pp.; In English; 10th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, 30 Aug. - 1 Sep. 2004, Albany, NY, USA
Contract(s)/Grant(s): 23-762-45-G2
Report No.(s): AIAA Paper 2004-4437; No Copyright; Avail: CASI; A03, Hardcopy

Due to the growing problem of noise in today's air transportation system, there have arisen needs to incorporate noise considerations in the conceptual design of revolutionary aircraft. Through the use of response surfaces, complex noise models may be converted into polynomial equations for rapid and simplified evaluation. This conversion allows many of the commonly used response surface-based trade space exploration methods to be applied to noise analysis. This methodology is demonstrated using a noise model of a notional 300 passenger Blended-Wing-Body (BWB) transport. Response surfaces are created relating source noise levels of the BWB vehicle to its corresponding FAR-36 certification noise levels and the resulting trade space is explored. Methods demonstrated include: single point analysis, parametric study, an optimization technique for inverse analysis, sensitivity studies, and probabilistic analysis. Extended applications of response surface-based methods in noise analysis are also discussed.
Author
Aircraft Design; Blended-Wing-Body Configurations; Noise Intensity; Optimization

20040110962 NASA Langley Research Center, Hampton, VA, USA
Sound Transmission through Two Concentric Cylindrical Sandwich Shells
Tang, Yvette Y.; Silcox, Richard J.; Robinson, Jay H.; [1996]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

This paper solves the problem of sound transmission through a system of two infinite concentric cylindrical sandwich shells. The shells are surrounded by external and internal fluid media and there is fluid (air) in the annular space between them. An oblique plane sound wave is incident upon the surface of the outer shell. A uniform flow is moving with a constant velocity in the external fluid medium. Classical thin shell theory is applied to the inner shell and first-order shear deformation theory is applied to the outer shell. A closed form for transmission loss is derived based on modal analysis. Investigations have been made for the impedance of both shells and the transmission loss through the shells from the exterior into the interior. Results are compared for double sandwich shells and single sandwich shells. This study shows that: (1) the impedance of the inner shell is much smaller than that of the outer shell so that the transmission loss is almost the same in both the annular space and the interior cavity of the shells; (2) the two concentric sandwich shells can produce an appreciable increase of transmission loss over single sandwich shells especially in the high frequency range; and (3) design guidelines may be derived with respect to the noise reduction requirement and the pressure in the annular space at a mid-frequency range.
Author
Sound Transmission; Sound Waves; Concentric Cylinders; Cylindrical Shells

20040110970 Research and Technology Organization, Neuilly-sur-Seine, France
Assessment Methods for Personal Active Noise Reduction Validated in an International Round Robin
Crabtree, Brian; Abel, Sharon; Dancer, Arman L.; Buck, Karl; Wessling, Thomas; Steeneken, Herman J. M.; Verhave, Jan A.; James, Susan Helen; Rood, Graham M.; McKinley, Richard; August 2004; 106 pp.; In English
Report No.(s): RTO-TR-HFM-094; AC/323(HFM-094)TP/53; Copyright; Avail: CASI; C01, CD-ROM; A06, Hardcopy

Methods used for the assessment of helmets and headsets equipped with Active Noise Reduction (ANR) are different from the (standardized) methods used for passive systems. ANR systems may introduce electronic noise and possess non-linear behavior at high noise levels. Therefore standard methods like comparison of subjective performance at threshold may not be valid. Alternative methods have been developed and compared in various laboratories. The performance of a number of test methods was assessed in an international Round Robin. Five laboratories participated in this test: DRDC Canada; ISL France-Germany; TNO-HF The Netherlands; QinetiQ UK, and AFRL/HECB USA. The passive and active sound attenuation of five headsets, all equipped with active noise reduction and an intercom, were determined. Several measuring methods were adopted including methods that are based on a human head, artificial head and artificial ear. With a human subject the maximum sound level is restricted due to a possible temporary or permanent hearing loss. Artificial ear and head based methods have no level limitation but may not be representative. This study presents a comparison of the validity of these methods. The speech intelligibility was predicted from measurements of the Speech Transmission Index (STI) and the Modified Rhyme Test (MRT). The personal comfort and performance of the headsets were evaluated subjectively. The results on attenuation show that most measuring methods are not significantly different. Also, inter and intra subject variance was small. The measurements covered the attenuation of the passive and active performance of the systems. The results presented in this report are focused on methods to determine the passive and active attenuation and speech communication quality. Also the speech communication measurements with subjects and with an artificial head show a good correlation. Various measuring methods for attenuation and speech communication quality were validated and found to be very useful for military applications.
Author
Noise Reduction; Helmets; Earphones

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*.

20040110477 Romanian Center for Induced Gamma Emission, Bucharest
New Perspectives for the Production and Accumulation of (178m2)Hf Isomers
Popescu, Ioan-Iovitz; Sep. 30, 2003; 21 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA8655-02-1-3069
Report No.(s): AD-A425282; EOARD-SPC-02-4069; No Copyright; Avail: CASI; A03, Hardcopy

This report results from a contract tasking Induced Gamma Emission Foundation as follows: The contractor will investigate the production and accumulation of the nuclear isomer 178m2 Hafnium by spallation of Tungsten targets with high-energy protons. Targets made of the isotope 186 Tungsten will be designed using the LAHET computer code, and fabricated for experimental verification. The Hafnium yield will be assayed and compared to LAHET calculations.
DTIC
Hafnium; Isomers

20040110750 Argonne National Lab., IL
MUSE-4 Experiment Measurements and Analysis
Aliberti, G.; Imel, G.; Palmiotti, G.; Sep. 2003; In English
Report No.(s): DE2004-821069; ANL-AFCI-092; No Copyright; Avail: National Technical Information Service (NTIS)

This report presents a review of the activities performed by the five teams involved in the MUSE-4 experimental program. More details are provided on the contribution by ANL during the year 9/02 to 9/03. The ANL activity consisted both in direct participation in the experimental measurements and in the physics analysis of the experimental data, mainly for the reactivity level, adjoint flux and fission rate distributions and the analysis of dynamic measurements for reactivity determination techniques in subcritical systems. The results provided to complete the Benchmark organized by the OECD and the CEA on

the experiment MUSE-4 are also presented. Deterministic calculations have been performed via the ERANOS code system in connection with JEF2.2, ENDF/B-V and ENDF/B-VI data files.
NTIS
Flux (Rate); Fission; Data Acquisition

20040110845 NASA Glenn Research Center, Cleveland, OH, USA
Digital Beam Steering Device Based on Decoupled Birefringent Prism Deflector and Polarization Rotator
Pishnyak, Oleg; Kreminska, Lyubov; Laventovich, Oleg D.; Pouch, John J.; Miranda, Felix A.; Winker, Bruce K.; August 2004; 29 pp.; In English
Contract(s)/Grant(s): NAG3-2539; WBS 22-319-80-A5
Report No.(s): NASA/TM-2004-213197; E-14696; No Copyright; Avail: CASI; A03, Hardcopy

We describe digital beam deflectors (DBDs) based on liquid crystals. Each stage of the device comprises a polarization rotator and a birefringent prism deflector. The birefringent prism deflects the beam by an angle that depends on polarization of the incident beam. The prism can be made of the uniaxial smectic A (SmA) liquid crystal (LC) or a solid crystal such as yttrium orthovanadate (YVO4). SmA prisms have high birefringence and can be constructed in a variety of shapes, including single prisms and prismatic blazed gratings of different angles and profiles. We address the challenges of uniform alignment of SmA, such as elimination of focal conic domains. Rotation of linear polarization is achieved by an electrically switched twisted nematic (TN) cell. A DBD composed of N rotator-deflector pairs steers the beam into 2(sup N) directions. As an example, we describe a four-stage DBD deflecting normally incident laser beam within the range of +/- 56 mrad with 8 mrad steps. Redirection of the beam is achieved by switching the TN cells.
Author
Beam Steering; Digital Command Systems; Liquid Crystals; Birefringence; Prisms; Deflectors

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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*.

20040100691 National Inst. of Standards and Technology, Gaithersburg, MD
Triangular Meshing and Volume Determination
Witzgall, C.; Cheok, G. S.; Jul. 2004; In English
Report No.(s): PB2004-106751; NISTIR-7142; No Copyright; Avail: National Technical Information Service (NTIS)

Parametric studies are reported which investigate the feasibility and accuracy of calculating volumes from LADAR (laser detection and ranging) scans of artifacts. The Triangulated Irregular Network (TIN) technique was employed to construct the surfaces on which the volume calculation was based. The artifact used was a plywood box of known size and volume. Scans were taken of a tight fitting background screen, with and without the box placed against it. The volume of the box was then recovered as the difference between respective cut or, alternatively, fill volumes. A procedure for determining such cut and fill volumes is described. The representation of point clouds by triangulated surfaces offers several algorithmic options as well as choices of parameters. The sensitivity and accuracy of volume calculations was examined for several alternative algorithmic options and parameter settings.
NTIS
Triangulation; Laser Range Finders; Optical Radar; Accuracy

20040110676 Lawrence Livermore National Lab., Livermore, CA
Advanced Solid-State Lasers
2004; In English
Report No.(s): DE2004-15007293; No Copyright; Avail: National Technical Information Service (NTIS)

This brochure concentrates on the diode-pumped solid-state laser. Surrounding it on the cover are some of the primary technological developments that make it a candidate for the means by which inertial confinement fusion will create inertial fusion energy as an inexhaustible source of electric power.
NTIS
Solid State Lasers; Diodes

20040110689 Lawrence Livermore National Lab., Livermore, CA
Laser Performance Operations Model (LPOM)
Shaw, M. J.; Williams, W. H.; House, R. K.; Haymant, C. A.; Jan. 07, 2004; In English
Report No.(s): DE2004-15007266; UCRL-CONF-155820; No Copyright; Avail: National Technical Information Service (NTIS)

The Laser Performance Operations Model (LPOM) has been developed to provide real time predictive capabilities for the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory. LPOM uses diagnostic feedback from previous NIF shots to maintain accurate energetics models for each of the 192 NIF beamlines (utilizing one CPU per laser beamline). This model is used to determine the system setpoints (initial power, waveplate attenuations, laser diagnostic settings) required for all requested NIF shots. In addition, LPOM employs optical damage models to minimize the probability that a proposed shot may damage the system. LPOM provides post-shot diagnostic reporting to support the NIF community. LPOM was deployed prior to the first main laser shots in NIF, and has since been used to set up every shot in NIF's first quad (four beamlines). Real-time adjustments of the codes energetics parameters allows the LPOM to predict total energies within 5%, and provide energy balance within the four beamlines to within 2% for shots varying from 0.5 to 26 kJ (1.053(micro)m) per beamline. The LPOM has been a crucial tool in the commissioning of the first quad of NIF.
NTIS
Damage; Performance Prediction; Laser Outputs; Real Time Operation

20040110704 Lawrence Livermore National Lab., Livermore, CA
Design of a Production Process to Enhance Optical Performance of 3 omega Optics
Prasad, R. R.; Bruere, J. R.; Halpin, J.; Lucero, P.; Mills, S.; Nov. 01, 2003; In English
Report No.(s): DE2004-15007261; UCRL-CONF-155396; No Copyright; Avail: National Technical Information Service (NTIS)

Using the Phoenix pre-production conditioning facility we have shown that raster scanning of 3w optics using a XeF excimer laser and mitigation of the resultant damage sites with a CO2 laser can enhance their optical damage resistance. Several large-scale (43 cm x 43 cm) optics have been processed in this facility. A production facility capable of processing several large optics a week has been designed based on our experience in the pre-production facility. The facility will be equipped with UV conditioning lasers - 351-nm XeF excimer lasers operating at 100 Hz and 23 ns. The facility will also include a CO2 laser for damage mitigation, an optics stage for raster scanning large-scale optics, a damage mapping system (DMS) that images large-scale optics and can detect damage sites or precursors as small as 15 microns, and two microscopes to image damage sites with 5 microns resolution. The optics will be handled in a class 100 clean room, within the facility that will be maintained at class 1000.
NTIS
Design Analysis; Manufacturing; Xenon Fluoride Lasers; Optical Equipment

20040110712 Lawrence Livermore National Lab., Livermore, CA
Large Aperture, High Energy Laser System for Optics and Optical Component Testing
Nostrand, M. C.; Weiland, T. L.; Luthi, R. L.; Vickers, J. L.; Sell, W. D.; Nov. 01, 2003; In English
Report No.(s): DE2004-15007260; UCRL-CONF-155394; No Copyright; Avail: National Technical Information Service (NTIS)

A large aperture, kJ-class, multi-wavelength Nd-glass laser system has been constructed at Lawrence Livermore National Lab which has unique capabilities for studying a wide variety of optical phenomena. The master-oscillator, power-amplifier (MOPA) configuration of this 'Optical Sciences Laser' (OSL) produces 1053 nm radiation with shaped pulse lengths which are variable from 0.1-100 ns. The output can be frequency doubled or tripled with high conversion efficiency with a resultant 100 cm(sup 2) high quality output beam. This facility can accommodate prototype hardware for large-scale inertial confinement fusion lasers allowing for investigation of integrated system issues such as optical lifetime at high fluence, optics contamination, compatibility of non-optical materials, and laser diagnostics.
NTIS
Apertures; Energy Conversion Efficiency; High Power Lasers; Optical Equipment

20040110752 Lawrence Livermore National Lab., Livermore, CA
Introduction to the National Ignition Facility
Moses, E. I.; Jan. 05, 2004; In English
Report No.(s): DE2004-15007230; UCRL-CONF-154962; No Copyright; Avail: National Technical Information Service (NTIS)

The National Ignition Facility (NIF) at the Lawrence Livermore National Laboratory is a stadium-sized facility containing a 192-beam, 1.8-Megajoule, 500-Terawatt, ultraviolet laser system together with a 10-meter diameter target chamber with room for nearly 100 experimental diagnostics. NIF will be the world's largest and most energetic laser experimental system, providing a scientific center to study inertial confinement fusion and matter at extreme energy densities and pressures. NIF's energetic laser beams will compress fusion targets to conditions required for thermonuclear bum, liberating more energy than required to initiate the fusion reactions. Other NIF experiments will study physical processes at temperatures approaching l08 K and 10 in. bar, conditions that exist naturally only in the interior of stars, planets and in nuclear weapons. NIF has completed the first phases of its laser commissioning program. The first four beams of NIF have generated 106 kilojoules of infrared light and over 16 kJ at the third harmonic (351 nm). NIF's target experimental systems are being commissioned and experiments have begun. This paper provides a detailed look the NIF laser systems, laser and optical performance and results from recent laser commissioning shots, and plans for commissioning diagnostics for experiments on NIF.
NTIS
Diagnosis; Research Facilities; Ultraviolet Lasers; Laser Beams; Inertial Confinement Fusion

20040110877 Syracuse Univ., NY, USA
LiNbO3 Cylinder Fiber
[2004]; 5 pp.; In English
Contract(s)/Grant(s): NAG5-12737; No Copyright; Avail: CASI; A01, Hardcopy

We have successfully fabricate optical fiber with a thin layer of LiNbO3 at the boundary of the glass core and dear glass cladding. The construction of this fiber is based on our successful Semiconductor Cylinder Fibers (SCF). A schematic representation of a LiNbO3 Cylinder Fiber is shown. These fibers can be used as light modulators, sonar detectors and in other applications. The core diameter of the fiber is sufficiently small compared to the light wavelength and the indices of refraction of the core and cladding glasses are sufficiently close in value so that there is sufficient light at the core cladding boundary to interact with the LiNbO3 layer. This fiber functions best when just a single light mode propagates through the fiber. The idea for a LiNbO3 Cylinder Fiber came from Dr. Tracee Jamison of NASA. The optical properties of LiNbO3 can be changed with strain or the application of an electric field. Thus these fibers can be used as acoustic sensors as for example in a sonar. They can also be used as electric field operated light modulators. However, for this application the fibers would be made with a cross section in the form of a 'D'. The core with its surrounding LiNbO, layer would be close to the flat portion of the 'D' shaped fiber. Two metal contacts would be deposited on the flat portion of the fiber on either side of the core. A voltage applied across these contacts will result in an electric field in the core region that can be used for modulating the optical properties of the LiNbO, layer. To our knowledge this is the first ever LiNbO, Cylinder Fiber made.
Author (revised)
Lithium Niobates; Optical Fibers; Cylindrical Bodies

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PLASMA PHYSICS

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

20040100761 Argonne National Lab., IL, USA
Development of Comprehensive Models for Opacities and Radiation Trasnport for IFE Systems
Tolkach, V.; Morozov, V.; Hassanein, A.; Jul. 2002; In English
Report No.(s): DE2003-820525; ANL-ET/02-23; No Copyright; Avail: National Technical Information Service (NTIS)

An ignition in an inertial confinement fusion (ICF) reactor results in X-ray spectra and ion fluxes moving toward the chamber wall with different velocities. During flight, parts of the energy will be deposited either in the residual and/or protective chamber gas or in the initial vapor cloud developed near the wall surface from vaporization. The deposited energy will be re-radiated to the chamber wall long after the ignition process. The exact amount of energy deposited/radiated and time of deposition are key issues in evaluating the chamber response and the economical feasibility of an ICF reactor. The radiation processes in the protective gas layer or in the vapor cloud developed above the first wall play an important role in the overall dynamics of the ICF chamber. A self-consistent field method has been developed to calculate ionization potentials, atom and ion energy levels, transition probabilities, and other atomic properties used to calculate thermodynamic and optical characteristics of the plasma by means of collisional-radiation equilibrium (CRE). The methodology of solving radiation

transport equations in spherical geometry and the dependence of results on the chosen theoretical model are demonstrated using the method of inward/outward directions.
NTIS
Opacity; Radiation Transport

20040110607 Princeton Univ., NJ
Beam Ion Driven Instabilities in NSTX
Gorelenkov, N. N.; Belova, E.; Berk, H. L.; Cheng, C. Z.; Fredrickson, E.; Nov. 2003; In English
Report No.(s): DE2004-820196; PPPL-3901; No Copyright; Avail: National Technical Information Service (NTIS)

A low-field, low-aspect-ratio device such as NSTX (National Spherical Torus Experiment) is an excellent testbed to study the ITER-relevant physics of fast-particle confinement that is of major importance for burning plasmas. The low Alfvin speed in NSTX offers a window to the super-Alfvinic regime expected in ITER. Effects such as the large FLR, orbit width, strong shaping, and high thermal and fast-ion betas make this effort a greater challenge. We report on the linear stability of different Alfvin eigenmode (AE) branches and compare theory with experimental data. Low-frequency MHD activities, (approx)100 kHz, on NSTX are often observed and identified as the toroidicity-induced AEs (TAE) driven by beam ions.
NTIS
Plasmas (Physics); Confinement

20040110610 Princeton Univ., NJ
Removable Thin Films Used for the Abatement and Mitigation of Beryllium
Lumia, M.; Gentile, C.; Creek, K.; Sandoval, R.; Nov. 2003; In English
Report No.(s): DE2004-820123; PPPL-3899; No Copyright; Avail: National Technical Information Service (NTIS)

The use of removable thin films for the abatement of hazardous particulates has many advantages. Removable thin films are designed to trap and fix particulates in the film's matrix by adhesion. Thin films can be applied to an existing contaminated area to fix and capture the particulates for removal. The nature of the removable thin films, after sufficient cure time, is such that it can typically be removed as one continuous entity. The removable thin films can be applied to almost any surface type with a high success rate of removal.
NTIS
Beryllium; Contamination

20040110615 Lawrence Livermore National Lab., Livermore, CA
Implications of Nanoabsorber Initiators for Damage Probability Curves, Pulselength Scaling and Laser Conditioning
Feit, M. D.; Rubenchik, A. M.; Nov. 01, 2003; In English
Report No.(s): DE2004-15007254; UCRL-CONF-153482; No Copyright; Avail: National Technical Information Service (NTIS)

Laser damage of large optics initiates at material imperfections. Absorbers of very small, nanoscale size are possible initiators. We will analyze experimental implications of assuming that the damage is initiated by a size distribution of nanoabsorbers. We will demonstrate that the model predicts damage fluence pulselength scaling consistent with experiment. The size distribution of nanoabsorbers is related to the resulting damage site density and to the shape of the damage probability curve (S-curve). Conditioning of KDP crystals can be explained within the same model. The relative efficiency of various conditioning strategies is discussed.
NTIS
Laser Damage; S Curves; Shapes; Size Distribution

20040110668 Princeton Univ., NJ
Next-Step Spherical Torus Experiment and Spherical Torus Strategy in the Fusion Energy Development Path
Ono, M.; Peng, M.; Kessel, C.; Neumeyer, C.; Schmidt, J.; Oct. 2003; In English
Report No.(s): DE2004-820116; PPPL-3893; No Copyright; Avail: National Technical Information Service (NTIS)

A spherical torus (ST) fusion energy development path which is complementary to proposed tokamak burning plasma experiments such as ITER is described. The ST strategy focuses on a compact Component Test Facility (CTF) and higher performance advanced regimes leading to more attractive DEMO and Power Plant scale reactors. To provide the physics basis for the CTF an intermediate step needs to be taken which we refer to as the 'Next Step Spherical Torus' (NSST) device and examine in some detail herein. NSST is a 'performance extension' (PE) stage ST with the plasma current of 5-10 MA, R=

1.5 m, and Beta(sub)T less than or equal to 2.7 T with flexible physics capability. The mission of NSST is to: (1) provide a sufficient physics basis for the design of CTF, (2) explore advanced operating scenarios with high bootstrap current fraction/high performance regimes, which can then be utilized by CTF, DEMO, and Power Plants, and (3) contribute to the general plasma/fusion science of high beta toroidal plasmas.
NTIS
Fusion Reactors; Toruses

20040110671 Princeton Univ., NJ
Physics of Substorm Growth Phase, Onset, and Dipolarization
Cheng, C. Z.; Oct. 2003; In English
Report No.(s): DE2004-820115; PPPL-3892; No Copyright; Avail: National Technical Information Service (NTIS)

A new scenario of substorm growth phase, onset, and depolarization during expansion phase and the corresponding physical processes are presented. During the growth phase, as a result of enhanced plasma convection, the plasma pressure and its gradient are continued to be enhanced over the quiet-time values in the plasma sheet. Toward the late growth phase, a strong cross-tail current sheet is formed in the near-Earth plasma sheet region, where a local magnetic well is formed, the plasma beta can reach a local maximum with value larger than 50 and the cross-tail current density can be enhanced to over 10nA/m(sup 2) as obtained from 3D quasi-static magnetospheric equilibrium solutions for the growth phase.
NTIS
Magnetic Storms; Plasma Dynamics; Current Density

20040110686 Lawrence Livermore National Lab., Livermore, CA
NIF Final Optics System: Frequency Conversion and Beam Conditioning
Wegner, P.; Auerbach, J.; Biesiada, T.; Dixit, S.; Lawson, J.; Jan. 28, 2004; In English
Report No.(s): DE2004-15007265; UCRL-CONF-155817; No Copyright; Avail: National Technical Information Service (NTIS)

Installation and commissioning of the first of forty-eight Final Optics Assemblies on the National Ignition Facility was completed this past year. This activity culminated in the delivery of first light to a target. The final optics design is described and selected results from first-article commissioning and performance tests are presented.
NTIS
Frequency Converters; Ignition; Performance Tests

20040110687 Lawrence Livermore National Lab., Livermore, CA
Limits to Enhanced IR Layering Set by Long Scale Ablator Roughness
Kozioziemski, B. J.; Dec. 12, 2003; In English
Report No.(s): DE2004-15007264; UCRL-TR-155814; No Copyright; Avail: National Technical Information Service (NTIS)

We show that long scale-length ablator roughness sets a limit to the enhanced IR layering power possible in a NIF ignition hohlraum. This limit can be more restrictive than the limit set by thermal conduction. High IR power absorption, characteristic of the ablator material, combined with ablator roughness can produce ice thickness variations which exceed the NIF ice layer roughness specification. For example, if the capsule IR absorption coefficient is greater than 13 /cm, the max IR power is less than the 4 Q(sub DT) limit set by thermal conduction.
NTIS
Surface Roughness; Conductive Heat Transfer; Hohlraums; Infrared Absorption

20040110688 Princeton Univ., NJ
NSTX High Field Side Gas Fueling System
Kugel, H. W.; Anderson, M.; Barnes, G.; Bell, M.; Blanchard, W.; Oct. 2003; In English
Report No.(s): DE2004-820084; PPPL-3881; No Copyright; Avail: National Technical Information Service (NTIS)

Fueling National Spherical Torus Experiment (NSTX) plasmas with gas injected from the high field side (HFS) has produced earlier, more reliable transitions to the H-mode, longer H-mode durations, higher toroidal rotation, and higher edge electron temperature compared with similar discharges using the low field side (LFS) gas fueling injectors. The HFS gas fueling system consists of a Center Stack midplane injector, and an injector at the inner, upper corner of the Center Stack. The challenging design and installation constraints for the HFS gas system involved placing the control components as close as possible to the machine-vacuum interface, devising a special feed-through flange, traversing through vessel regions whose

temperatures during bake-out range from 150 to 350 degrees Centigrade, adapting the gas transport tubing size and route to the small instrumentation wire channels behind the existing graphite plasma facing component tiles on the Center Stack, and providing output orifices shielded from excessive plasma power depositions while concentrating the output flow to facilitate fast camera viewing and analysis.
NTIS
Plasmas (Physics); Spherical Plasmas; Refueling

20040110699 Westinghouse Savannah River Co., Aiken, SC, USA
Determination of Reportable Radionuclides for DWPF Sludge Batch 2 (Macro Batch 3)
Bibler, N. E.; DiPrete, D. P.; Harbour, J. R.; Sep. 13, 2002; 26 pp.; In English
Report No.(s): DE2004-806908; WSRC-TR-2002-00255; No Copyright; Avail: Department of Energy Information Bridge
The Waste Acceptance Product Specifications (WAPS) 1.2 require that ''The Producer shall report the inventory of radionuclides (in Curies) that have half-lives longer than 10 years and that are, or will be, present in concentrations greater than 0.05 percent of the total inventory for each waste type indexed to the years 2015 and 3115''. As part of the strategy to meet WAPS 1.2, the Defense Waste Processing Facility (DWPF) will report for each waste type, all radionuclides (with half-lives greater than 10 years) that have concentrations greater than 0.01 percent of the total inventory from time of production through the 1100 year period from 2015 through 3115. The initial listing of radionuclides to be included is based on the design-basis glass as identified in the Waste Form Compliance Plan (WCP) and Waste Form Qualification Report (WQR). However, it is required that this list be expanded if other radionuclides with half-lives greater than 10 years are identified that meet the greater than 0.01 percent criterion for Curie content.
NTIS
Sludge; Radioactive Isotopes

20040110749 General Atomics Co., San Diego, CA
Advanced Fusion Technology Research and Development. Annual Report October 1, 2001 through September 30, 2002
Dec. 2003; In English
Report No.(s): DE2004-821588; GA-A24304; No Copyright; Avail: National Technical Information Service (NTIS)
OAK-B135 The General Atomics (GA) Advanced Fusion Technology program seeks to advance the knowledge base needed for next-generation fusion experiments and, ultimately, for an economical and environmentally attractive fusion energy source. To achieve this objective, we carry out fusion systems design studies to evaluate the technologies needed for next-step experiments and power plants, and we conduct research to develop basic and applied knowledge about these technologies. GA's Advanced Fusion Technology program derives from, and draws on, the physics and engineering expertise built up by many years of experience in designing, building, and operating plasma physics experiments. Our technology development activities take full advantage of the GA DIII-D program, the DIII-D facility and the Inertial Confinement Fusion (ICF) program and the ICF Target Fabrication facility. The following sections summarize GA's FY02 work in the areas of Fusion Power Plant Studies (ARIES, Section 2), Inertial Fusion Energy (IFE) Chamber Analysis (Section 3), IFE Target Supply System Development (Section 4), Next Step Fusion Design (Section 5), Advanced Liquid Plasma Facing Surfaces (ALPS, Section 6), Advanced Power Extraction Study (APEX, Section 7), Plasma Interactive Materials (DiMES, Section 8) and RF Technology (Section 9). Our work in these areas continues to address many of the issues that must be resolved for the successful construction and operation of next-generation experiments and, ultimately, the development of safe, reliable, economic fusion power plants.
NTIS
Technology Assessment; Plasmas (Physics); Inertial Confinement Fusion; Extraction

20040110754 Lawrence Livermore National Lab., Livermore, CA
Magnetorheological Finishing for Imprinting Continuous Phase Plate Structure onto Optical Surfaces
Menapace, J. A.; Dixit, S. N.; Genin, F. Y.; Brocious, W. F.; Jan. 05, 2004; 18 pp.; In English
Report No.(s): DE2004-15007229; UCRL-CONF-153850; No Copyright; Avail: Department of Energy Information Bridge
Magnetorheological finishing (MRF) techniques have been developed to manufacture continuous phase plates (CPP's) and custom phase corrective structures on polished fused silica surfaces. These phase structures are important for laser applications requiring precise manipulation and control of beam-shape, energy distribution, and wavefront profile. The MRF's unique deterministic-sub-aperture polishing characteristics make it possible to imprint complex topographical information onto optical surfaces at spatial scale-lengths approaching 1 mm. In this study, we present the results of experiments and model

calculations that explore imprinting two-dimensional sinusoidal structures. Results show how the MRF removal function impacts and limits imprint fidelity and what must be done to arrive at a high quality surface. We also present several examples of this imprinting technology for fabrication of phase correction plates and CPPs for use at high fluences.
NTIS
Laser Applications; Silica Glass

20040110756 Lawrence Livermore National Lab., Livermore, CA
Nuclear Fusion in Gases of Deuterium Clusters and Hot Electron Generation in Droplet Sprays Under Irradiation with an Intense Femtosecond Laser
Ditmire, T.; Zweiback, J.; Cowan, T. E.; Hays, G.; Wharton, K. B.; Jul. 18, 2001; 20 pp.; In English
Report No.(s): DE2004-15007223; UCRL-JC-144727-R1; No Copyright; Avail: Department of Energy Information Bridge
We have observed the production of 2.45 MeV deuterium fusion neutrons when a gas of deuterium clusters is irradiated with a 120 mJ, 35 fs laser pulse. When the focal position is optimized, we have observed as many as 10(sup 4) neutrons per laser shot. This yield is consistent with some simple estimates for the fusion yield. We also find that the fusion yield is a sensitive function of the deuterium cluster size in the target jet, a consequence of the Coulomb explosion origin of the fast deuterons. We also find that the neutron pulse duration is fast, with a characteristic burn time of well under 1 ns. This experiment may represent a means for producing a compact, table-top source of short pulse fusion neutrons for applications. Furthermore, we have measured hard x-ray yield from femtosecond laser interactions with both solid and micron scale droplet targets. Strong hard x-ray production is observed from both targets. However, the inferred electron temperature is somewhat higher in the case of irradiation of the droplets. These data are consistent with PIC simulations. This finding indicates that quite unique hot electron dynamics occur during the irradiation of wavelength scale particles by an intense laser field and likely warrants further study.
NTIS
Deuterium; Nuclear Fusion; Gases; Clusters; Hot Electrons; Laser Outputs

20040110762 Lawrence Livermore National Lab., Livermore, CA
Interferometric Diagnosis of Two-Dimensional Plasma Expansion
Smith, R. F.; Moon, S.; Dunn, J.; Nilsen, J.; Shlyaptsev, V. N.; Jul. 31, 2002; 12 pp.; In English
Report No.(s): DE2004-15005135; UCRL-JC-149106; No Copyright; Avail: Department of Energy Information Bridge
Recent advances in interferometry has allowed for the characterization of the electron density expansion within a laser produced plasma to within 10(micro)m of the target surface and over picosecond timescales. This technique employs the high brightness output of the transient gain Ni-like Pd collisional x-ray laser at 14. 7 nm to construct an effective moving picture of the two-dimensional (2-D) expansion within the plasma. In this paper we present experimentally measured density profiles from an Al plasma and make comparisons with 1. 5-D and 2-D code simulations. The results are discussed along with an analysis of the underlying mechanisms driving the plasma expansion.
NTIS
Interferometry; Diagnosis; Two Dimensional Models; Laser Plasmas; Electron Density (Concentration)

20040110763 Lawrence Livermore National Lab., Livermore, CA
Investigation of the Electronic Structure of Solid Density Plasmas by X-ray Scattering
Gregori, G.; Glenzer, S. H.; Forest, F. J.; Kuhlbrodt, S.; Redmer, R.; May 19, 2003; In English
Report No.(s): DE2004-15005133; UCRL-ID-153671; No Copyright; Avail: National Technical Information Service (NTIS)
We present an improved analytical expression for the x-ray dynamic structure factor from a dense plasma which includes the effects of weakly bound electrons. This result can be applied to describe scattering from low to moderate Z plasmas, and it covers the entire range of plasma conditions that can be found in inertial confinement fusion experiments, from ideal to degenerate up to moderately coupled systems. We use our theory to interpret x-ray scattering experiments from solid density carbon plasma and to extract accurate measurements of electron temperature, electron density and charge state. We use our experimental results to validate various equation-of-state models for carbon plasmas.
NTIS
X Ray Scattering; Dynamic Structural Analysis; Dense Plasmas; Electronic Structure; Electron Density (Concentration)

20040110843 NASA Glenn Research Center, Cleveland, OH, USA
Observation of Quartz Cathode-Luminescence in a Low Pressure Plasma Discharge
Foster, John E.; July 2004; 15 pp.; In English
Contract(s)/Grant(s): WBS 22-982-10-02
Report No.(s): NASA/TM-2004-213128; E-14621; No Copyright; Avail: CASI; A03, Hardcopy

Intense, steady-state cathode-luminescence has been observed from exposure of quartz powder to a low pressure rf-excited argon plasma discharge. The emission spectra (400 to 850 nm) associated with the powder luminescence were documented as a function of bias voltage using a spectrometer. The emission was broad-band, essentially washing out the line spectra features of the argon plasma discharge.
Author
Quartz; Cathodes; Luminescence; Argon Plasma; Emission Spectra

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SOLID-STATE PHYSICS

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

20040100736 Argonne National Lab., IL
Physics Division Annual Report 2002
2003; In English
Report No.(s): DE2003-816757; ANL-03/23; No Copyright; Avail: National Technical Information Service (NTIS)

This report highlights the research performed in 2002 in the Physics Division of Argonne National Laboratory. The Division's programs include operation of ATLAS as a national user facility, nuclear structure and reaction research, nuclear theory, medium energy nuclear research and accelerator research and development.
NTIS
Particle Accelerators; Nuclear Research

20040110242 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Enhancements to a Superconducting Quantum Interference Device (SQUID) Multiplexer Readout and Control System
Forgione, J.; Benford, D. J.; Buchanan, E. D.; Moseley, S. H.; Rebar, J.; Shafer, R. A.; May 2004; 12 pp.; In English; SPIE Astronomical Telescopes and Instrumentation Conference, June 2004, Glasgow, Scotland, UK; No Copyright; Avail: CASI; A03, Hardcopy

Far-infrared detector arrays such as the 16x32 superconducting bolometer array for the SAFIRE instrument (flying on the SOFIA airborne observatory) require systems of readout and control electronics to provide translation between a user-driven, digital PC and the cold, analog world of the cryogenic detector. In 2001, the National Institute of Standards and Technology (NIST) developed their Mark III electronics for purposes of control and readout of their 1x32 SQUID Multiplexer chips. We at NASA s Goddard Space Flight Center acquired a Mark 111 system and subsequently designed upgrades to suit our and our collaborators purposes. We developed an arbitrary, programmable multiplexing system that allows the user to cycle through rows in a SQUID array in an infinite number of combinations. We provided hooks in the Mark III system to allow readout of signals from outside the Mark 111 system, such as telescope status information. Finally, we augmented the heart of the system with a new feedback algorithm implementation, flexible diagnostic tools, and informative telemetry.
Author
Squid (Detectors); Superconductivity; Control Systems Design; Multiplexing; Quantum Mechanics; Cryogenics; Sensors

20040110251 NASA Langley Research Center, Hampton, VA, USA
Piezoelectric Power Requirements for Active Vibration Control
Brennan, Matthew C.; McGowan, Anna-Maria Rivas; [1997]; 10 pp.; In English
Contract(s)/Grant(s): NCC1-208; No Copyright; Avail: CASI; A02, Hardcopy

This paper presents a method for predicting the power consumption of piezoelectric actuators utilized for active vibration control. Analytical developments and experimental tests show that the maximum power required to control a structure using surface-bonded piezoelectric actuators is independent of the dynamics between the piezoelectric actuator and the host structure. The results demonstrate that for a perfectly-controlled system, the power consumption is a function of the quantity and type of piezoelectric actuators and the voltage and frequency of the control law output signal. Furthermore, as control

effectiveness decreases, the power consumption of the piezoelectric actuators decreases. In addition, experimental results revealed a non-linear behavior in the material properties of piezoelectric actuators. The material non- linearity displayed a significant increase in capacitance with an increase in excitation voltage. Tests show that if the non-linearity of the capacitance was accounted for, a conservative estimate of the power can easily be determined.
Author
Active Control; Piezoelectric Actuators; Mathematical Models; Electric Power; Electrical Impedance; Vibration Damping

20040110254 NASA Langley Research Center, Hampton, VA, USA
Thermal Design and Analysis for the Cryogenic MIDAS Experiment
Amundsen, Ruth McElroy; [1997]; 9 pp.; In English
Report No.(s): Paper-97ES-29; No Copyright; Avail: CASI; A02, Hardcopy

The Materials In Devices As Superconductors (MIDAS) spaceflight experiment is a NASA payload which launched in September 1996 on the Shuttle, and was transferred to the Mir Space Station for several months of operation. MIDAS was developed and built at NASA Langley Research Center (LaRC). The primary objective of the experiment was to determine the effects of microgravity and spaceflight on the electrical properties of high-temperature superconductive (HTS) materials. The thermal challenge on MIDAS was to maintain the superconductive specimens at or below 80 K for the entire operation of the experiment, including all ground testing and 90 days of spaceflight operation. Cooling was provided by a small tactical cryocooler. The superconductive specimens and the coldfinger of the cryocooler were mounted in a vacuum chamber, with vacuum levels maintained by an ion pump. The entire experiment was mounted for operation in a stowage locker inside Mir, with the only heat dissipation capability provided by a cooling fan exhausting to the habitable compartment. The thermal environment on Mir can potentially vary over the range 5 to 40 C; this was the range used in testing, and this wide range adds to the difficulty in managing the power dissipated from the experiment's active components. Many issues in the thermal design are discussed, including: thermal isolation methods for the cryogenic samples; design for cooling to cryogenic temperatures; cryogenic epoxy bonds; management of ambient temperature components self-heating; and fan cooling of the enclosed locker. Results of the design are also considered, including the thermal gradients across the HTS samples and cryogenic thermal strap, electronics and thermal sensor cryogenic performance, and differences between ground and flight performance. Modeling was performed in both SINDA-85 and MSC/PATRAN (with direct geometry import from the CAD design tool Pro/Engineer). Advantages of both types of models are discussed. Correlation of several models to ground testing and flight data (where available) is presented. Both SINDA and PATRAN models predicted the actual thermal performance of the experiment well, even without post-flight correlation adjustments of the models.
Author
Cryogenic Temperature; Microgravity; Electrical Properties; Space Flight; High Temperature Superconductors; Ybco Superconductors; Bscco Superconductors; Design Analysis

20040110263 NASA Langley Research Center, Hampton, VA, USA
Design and Development of an Optical Path Difference Scan Mechanism for Fourier Transform Spectrometers using High Displacement RAINBOW Actuators
Wise, Stephanie A.; Hardy, Robin C.; Dausch, David E.; [1997]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A new piezoelectric drive mechanism has been developed for optical translation in space-based spectrometer systems. The mechanism utilizes a stack of RAINBOW high displacement piezoelectric actuators to move optical components weighing less than 250 grams through a one centimeter travel. The mechanism uses the direct motion of the piezoelectric devices, stacked such that the displacement of the individual RAINBOW actuators is additive. A prototype device has been built which utilizes 21 RAINBOWs to accomplish the necessary travel. The mechanism weighs approximately 0.6 kilograms and uses less than 2 Watts of power at a scanning frequency of 0.5 Hertz, significantly less power than that required by state-of-the-art motor systems.
Author
Displacement; Fourier Transformation; Optical Paths; Piezoelectric Actuators; Spectrometers; Fabrication; Scanners

20040110573 Fermi National Accelerator Lab., Batavia, IL, USA, California Univ., Santa Barbara, CA, USA
Operational Experience and Performance of the CDFII Silicon Detector
Hill, C. S.; Jan. 2004; In English
Report No.(s): DE2004-820745; FERMILAB-CONF-03/412-E; No Copyright; Avail: National Technical Information Service (NTIS)

The CDFII silicon detector consists of 8 layers of double-sided silicon micro-strip sensors totaling 722, 432 readout channels, making it one of the largest silicon detectors in present use by an HEP experiment. After nearly two years of data taking, we report on our experience operating the complex device. The performance of the CDFII silicon detector is presented and its effect on physics analyses is discussed. The CDFII silicon detector has begun to show measurable effects of radiation damage. These results and their impact on the expected lifetime of the detector are briefly reviewed.
NTIS
Silicon; Radiation Effects

20040110646 Lawrence Livermore National Lab., Livermore, CA
Relative Stability of Silicon Self-Interstitial Defects
Subramanian, G.; Jones, K. S.; Law, M. E.; Caturla, M. J.; Theiss, S.; Apr. 11, 2000; 12 pp.; In English
Report No.(s): DE2004-15007528; UCRL-JC-138808; No Copyright; Avail: Department of Energy Information Bridge
No abstract available
Defects; Silicon

20040110675 Lawrence Livermore National Lab., Livermore, CA
Chirped-Pulse Inverse Free Electron Laser: A Tabletop, High-Gradient Vacuum Laser Accelerator
Hartemann, F. V.; Troha, A. L.; Baldis, H. A.; Mar. 05, 2001; 32 pp.; In English
Report No.(s): DE2004-15007297; UCRL-ID-142788; No Copyright; Avail: Department of Energy Information Bridge
The inverse free-electron laser (IFEL) interaction is studied both theoretically and numerically in the case where the drive laser intensity approaches the relativistic regime, and the pulse duration is only a few optical cycles long. We show that by using an ultrashort, ultrahigh-intensity drive laser pulse, the IFEL interaction bandwidth and accelerating gradient are increased considerably, thus yielding large energy gains. Using a chirped pulse and negative dispersion focusing optics allows one to take further advantage of the laser optical bandwidth and produce a chromatic line focus maximizing the gradient. The combination of these novel ideas results in a compact vacuum laser accelerator capable of accelerating picosecond electron bunches with a high gradient (GeV/m) and very low energy spread. A computer code which takes into account the three-dimensional nature of the interaction is currently in development and results are expected this Spring.
NTIS
Free Electron Lasers; Computer Programs; Numerical Analysis; Electromagnetic Interactions

20040110759 Lawrence Livermore National Lab., Livermore, CA
Periodic Boundary Conditions for Dislocation Dynamics Simulations in Three Dimensions
Bulatov, V. V.; Rhee, M.; Cai, W.; Nov. 20, 2000; 14 pp.; In English
Report No.(s): DE2004-15005160; UCRL-JC-141458; No Copyright; Avail: Department of Energy Information Bridge
This article presents an implementation of periodic boundary conditions (PBC) for Dislocation Dynamics (DD) simulations in three dimensions (3D). We discuss fundamental aspects of PBC development, including preservation of translational invariance and line connectivity, the choice of initial configurations compatible with PBC and a consistent treatment of image stress. On the practical side, our approach reduces to manageable proportions the computational burden of updating the long-range elastic interactions among dislocation segments. The timing data confirms feasibility and practicality of PBC for large-scale DD simulations in 3D.
NTIS
Boundary Conditions; Simulation; Dislocations (Materials)

20040111012 NASA Glenn Research Center, Cleveland, OH, USA
Step Free Surface Heteroepitaxy of 3C-SiC Layers on Patterned 4H/6H-SiC Mesas and Cantilevers
Neudeck, Philip G.; Powell, J. Anthony; Trunek, Andrew J.; Spry, David J.; [2003]; 31 pp.; In English; Case Western Reserve University Materials Science and Engineering Colloquium, 25 Nov. 2003, USA
Contract(s)/Grant(s): 714-07-09; Copyright; Avail: CASI; A03, Hardcopy
Most SiC devices are implemented in homoepitaxial films grown on 4H/6H-SiC wafers with surfaces 3 degrees to 8 degrees off-axis from the (0001) basal plane. This approach has not prevented many substrate crystal defects from propagating into SiC epilayers, and does not permit the realization of SiC heteropolytype devices. This presentation describes recent advances in SiC epitaxial growth that begun to overcome the above shortcomings for arrays of mesas patterned into on-axis 4H/6H-SiC wafers. First, we demonstrated that atomic-scale surface steps can be completely eliminated from 4H/6H-SiC

mesas via on-axis homoepitaxial step-flow growth, forming (0001) basal plane surfaces (up to 0.4 mm x 0.4 mm) for larger than previously thought possible. Step-free surface areas were then extended by growth fo thin lateral cantilevers from the mesa tops. These lateral cantilevers enabled substrate defects to be reduced and relocated in homoepitaxial films in a manner not possible with off-axis SiC growth. Finally, growth of vastly improved 3C-SiC heterofilms was achieved on 4H/6H-SiC mesas using the recently develop step-free surface heteroepitaxy process. These epitaxial growth developments should enable improved homojunction and heterojunction silicon carbide prototype devices.
Author
Epitaxy; Heterojunction Devices; Mesas; Silicon Carbides; Cantilever Beams

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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*.

20040095958 NASA Langley Research Center, Hampton, VA, USA
S'COOL Takes Students to New Heights
Green, Carolyn J.; Chambers, Lin H.; [1998]; 1 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Students Cloud Observations On-Line (S'COOL) is a hands-on educational project which supports NASA's Clouds and the Earth s Radiant Energy System (CERES) satellite instrument; part of the Earth Science Enterprise studying our planet. S'COOL meets science, math, technology and geography Standards of Learning (SOLs) as students observe clouds and related weather conditions, compute data and locate vital information while obtaining ground truth observations for the CERES instrument. These observations can then be used to help validate the CERES measurements; particularly detection of clear sky from space. Participants to date have been in 20 states and 5 countries and have reported great interest and learning among their students. Many have used this project as a stepping stone to further learning in other areas of Earth Science; and to do more with the Internet in the classroom. Satellite images and clues to their interpretation are used on the website (http://asd-www.larc.nasa.gov/SCOOL/) . Background information is also given on Earth's Radiation Budget and it s importance in understanding our climate. Students can retrieve both their observations and the corresponding satellite data and participate in the validation efforts. A number of suggestions for studies to be done with the data, and related lesson plans, are available. Teachers can tailor this project to the appropriate level and subject matter needed for their students. The recommended grade level is 4th through 12th grade. The project is now open to new participants. We particularly seek schools in more remote areas, to obtain wider geographic coverage for ground truth data; so the project has been designed to use, but not require, computer technology. AGU participants attending the S'COOL presentation will be given a handout describing the project. Material for introducing the project in the classroom will be demonstrated in a participatory style.
Author
Clouds (Meteorology); Earth Radiation Budget; Education; Satellite Imagery

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ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

20040105520 NASA Langley Research Center, Hampton, VA, USA
Application Frontiers of 'Designer Fluid Mechanics"--Visions Versus Reality or An Attempt to Answer the Perennial Question 'Why Isn't It Used?"
Bushnell, Dennis M.; [2004]; 16 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Any new concept must successfully transit two sequential filters between research initiation and application, a technical filter (does it work?) and a technological filter (does it make sense in the real world?). In general, the research community is not sufficiently knowledgeable regarding the myriad metrics of the technological filter and therefore non (application) useful research is conducted in some cases and in others the research is not carried far enough to allow technological evaluation. It is becoming imperative that the research community be more knowledgeable concerning, and in many cases work with, the application community.
Author
Design Analysis; Technological Forecasting; Management Planning

20040105577 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Using CMMI for Improvement at GSFC
Godfrey, Sara H.; June 1, 2004; 42 pp.; In English; Systems Engineering Lecture Series, 1 Jun. 2004, Greenbelt, MD, USA; No Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation discusses the Capability Maturity Model Integrated (CMMI) is an integrated framework for maturity models and associated products that integrates the two key disciplines that are inseparable in a systems development activity: software engineering and systems engineering.
Derived from text
Systems Engineering; Software Engineering

20040110404 NASA Langley Research Center, Hampton, VA, USA
Flight Crew Task Management in Non-Normal Situations
Schutte, Paul C.; Trujillo, Anna C.; [1996]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Task management (TM) is always performed on the flight deck, although not always explicitly, consistently, or rigorously. Nowhere is TM as important as it is in dealing with non-normal situations. The objective of this study was to analyze pilot TM behavior for non-normal situations. Specifically, the study observed pilots performance in a full workload environment in order to discern their TM strategies. This study identified four different TM prioritization and allocation strategies: Aviate-Navigate-Communicate-Manage Systems; Perceived Severity; Procedure Based; and Event/Interrupt Driven. Subjects used these strategies to manage their personal workload and to schedule monitoring and assessment of the situation. The Perceived Severity strategy for personal workload management combined with the Aviate-Navigate-Communicate-Manage Systems strategy for monitoring and assessing appeared to be the most effective (fewest errors and fastest response times) in responding to the novel system failure used in this study.
Author
Flight Crews; Tasks; Civil Aviation; Systems Management; Communication

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DOCUMENTATION AND INFORMATION SCIENCE

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

20040095944 NASA Langley Research Center, Hampton, VA, USA
A Multi-Discipline, Multi-Genre Digital Library for Research and Education
Nelson, Michael L.; Maly, Kurt; Shen, Stewart N. T.; [2004]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

We describe NCSTRL+, a unified, canonical digital library for educational and scientific and technical information (STI). NCSTRL+ is based on the Networked Computer Science Technical Report Library (NCSTRL), a World Wide Web (WWW) accessible digital library (DL) that provides access to over 100 university departments and laboratories. NCSTRL+ implements two new technologies: cluster functionality and publishing 'buckets". We have extended the Dienst protocol, the protocol underlying NCSTRL, to provide the ability to 'cluster' independent collections into a logically centralized digital library based upon subject category classification, type of organization, and genres of material. The concept of 'buckets' provides a mechanism for publishing and managing logically linked entities with multiple data formats. The NCSTRL+ prototype DL contains the holdings of NCSTRL and the NASA Technical Report Server (NTRS). The prototype demonstrates the feasibility of publishing into a multi-cluster DL, searching across clusters, and storing and presenting buckets of information.
Author
Classifications; Libraries; Digital Data; Collection

20040095950 NASA Langley Research Center, Hampton, VA, USA
Digital Archive Issues from the Perspective of an Earth Science Data Producer
Barkstrom, Bruce R.; [2004]; 25 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Contents include the following: Introduction. A Producer Perspective on Earth Science Data. Data Producers as Members of a Scientific Community. Some Unique Characteristics of Scientific Data. Spatial and Temporal Sampling for Earth (or Space) Science Data. The Influence of the Data Production System Architecture. The Spatial and Temporal Structures Underlying Earth Science Data. Earth Science Data File (or Relation) Schemas. Data Producer Configuration Management

Complexities. The Topology of Earth Science Data Inventories. Some Thoughts on the User Perspective. Science Data User Communities. Spatial and Temporal Structure Needs of Different Users. User Spatial Objects. Data Search Services. Inventory Search. Parameter (Keyword) Search. Metadata Searches. Documentation Search. Secondary Index Search. Print Technology and Hypertext. Inter-Data Collection Configuration Management Issues. An Archive View. Producer Data Ingest and Production. User Data Searching and Distribution. Subsetting and Supersetting. Semantic Requirements for Data Interchange. Tentative Conclusions. An Object Oriented View of Archive Information Evolution. Scientific Data Archival Issues. A Perspective on the Future of Digital Archives for Scientific Data. References Index for this paper.
CASI
Data Acquisition; Data Management; Digital Data; Topology; Earth Sciences

20040100688 General Accounting Office, Washington, DC
Geospatial Information: Better Coordination Needed to Identify and Reduce Deplicative Investments
Jun. 2004; In English
Report No.(s): PB2004-106136; GAO-04-703; No Copyright; Avail: National Technical Information Service (NTIS)

From homeland security to tracking outbreaks of disease, to investigating the space shuttle disaster to responding to natural disasters, the collection, maintenance, and use of location-based (geospatial) information has become critical to many federal agencies abilities to achieve their goals. Local governments and the private sector also rely on such data to support essential functions. GAO was asked to determine the extent to which the federal government is coordinating the sharing of geospatial assets, including through oversight measures in place at the Office of Management and Budget (OMB), in order to identify and reduce redundancies in geospatial data and systems. GAO is making recommendations to the Director of OMB and the Secretary of the Interior to direct development of a national geospatial strategic plan, and recommendations to the Director of OMB to develop criteria for assessing interagency coordination on proposals for potential geospatial investments, and strengthen its oversight of geospatial projects. In providing oral comments on a draft of this report, OMB and Department of the Interior officials generally agreed with its content and recommendations.
NTIS
Investments; Data Systems; Strategy

20040100707 NASA Langley Research Center, Hampton, VA, USA
NCSTRL+: Adding Multi-Discipline and Multi-Genre Support to the Dienst Protocol Using Clusters and Buckets
Nelson, Michael L.; Maly, Kurt; Shen, Stewart N. T.; Zubair, Mohammad; Proceedings of the IEEE Forum on Research and Technology Advances in Digital Libraries; [1998], pp. 128-136; In English; IEEE Forum on Research and Technology Advances in Digital Libraries, 22-24 Apr. 1998, Santa Barbara, CA, USA; No Copyright; Avail: CASI; A02, Hardcopy

We describe NCSTRL+, a unified, canonical digital library for scientific and technical information (STI). NCSTRL+ is based on the Networked Computer Science Technical Report Library (NCSTRL), a World Wide Web (WWW) accessible digital library (DL) that provides access to over 100 university departments and laboratories. NCSTRL+ implements two new technologies: cluster functionality and publishing buckets. We have extended Dienst, the protocol underlying NCSTRL, to provide the ability to cluster independent collections into a logically centralized digital library based upon subject category classification, type of organization, and genres of material. The bucket construct provides a mechanism for publishing and managing logically linked entities with multiple data forms as a single object. The NCSTRL+ prototype DL contains the holdings of NCSTRL and the NASA Technical Report Server (NTRS). The prototype demonstrates the feasibility of publishing into a multi-cluster DL, searching across clusters, and storing and presenting buckets of information.
Author
Integrated Library Systems; Digital Data; Information Management; Libraries; Classifications; Digital Systems; Protocol (Computers)

20040105663 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Value-added Data Services at the Goddard Earth Sciences Data and Information Services Center
Leptoukh, Gregory G.; Alcott, Gary T.; Kempler, Steven J.; Lynnes, Christopher S.; Vollmer, Bruce E.; [2004]; 1 pp.; In English; AGU/CGU/SEG/EEGS 2004 Joint Assembly, 17-21 May 2004, Montreal, Canada; No Copyright; Avail: Other Sources; Abstract Only

The NASA Goddard Earth Sciences Data and Information Services Center (GES DISC), in addition to serving the Earth Science community as one of the major Distributed Active Archives Centers (DAACs), provides much more than just data. Among the value-added services available to general users are subsetting data spatially and/or by parameter, online analysis

(to avoid downloading unnecessarily all the data), and assistance in obtaining data from other centers. Services available to data producers and high-volume users include consulting on building new products with standard formats and metadata and construction of data management systems. A particularly useful service is data processing at the DISC (i.e., close to the input data) with the users algorithm. This can take a number of different forms: as a configuration-managed algorithm within the main processing stream; as a stand-alone program next to the on-line data storage; as build-it-yourself code within the Near-Archive Data Mining (NADM) system; or as an on-the-fly analysis with simple algorithms embedded into the web-based tools. Partnerships between the GES DISC and scientists, both producers and users, allow the scientists to concentrate on science, while the GES DISC handles the data management, e.g., formats, integration, and data processing. The existing data management infrastructure at the GES DISC supports a wide spectrum of options: from simple data support to sophisticated on-line analysis tools, producing economies of scale and rapid time-to-deploy. At the same time, such partnerships allow the GES DISC to serve the user community more efficiently and to better prioritize on-line holdings. Several examples of successful partnerships are described in the presentation.
Author (revised)
Earth Sciences; Data Management

20040110308 NASA, Washington, DC, USA
National Aeronautics and Space Administration Exploration Systems Interim Strategy
[August 2004]; 87 pp.; In English
Report No.(s): NASA/NP-2004-07-362-HQ; No Copyright; Avail: CASI; A05, Hardcopy

Contents include the following: 1. The Exploration Systems Mission Directorate within NASA. Enabling the Vision for Space Exploration. The Role of the Directorate. 2. Strategic Context and Approach. Corporate Focus. Focused, Prioritized Requirements. Spiral Transformation. Management Rigor. 3. Achieving Directorate Objectives. Strategy to Task Process. Capability Development. Research and Technology Development. 4. Beyond the Horizon. Appendices.
CASI
NASA Programs; Space Exploration

20040110316 NASA Langley Research Center, Hampton, VA, USA
Evolution of Scientific and Technical Information Distribution
Esler, Sandra; Nelson, Michael L.; Journal of the American Society for Information Science; 1998; Volume 49, No. 1, pp. 82-91; In English; Copyright; Avail: CASI; A03, Hardcopy

World Wide Web (WWW) and related information technologies are transforming the distribution of scientific and technical information (STI). We examine 11 recent, functioning digital libraries focusing on the distribution of STI publications, including journal articles, conference papers, and technical reports. We introduce 4 main categories of digital library projects: based on the architecture (distributed vs. centralized) and the contributor (traditional publisher vs. authoring individual/organization). Many digital library prototypes merely automate existing publishing practices or focus solely on the digitization of the publishing cycle output, not sampling and capturing elements of the input. Still others do not consider for distribution the large body of 'gray literature.' We address these deficiencies in the current model of STI exchange by suggesting methods for expanding the scope and target of digital libraries by focusing on a greater source of technical publications and using 'buckets,' an object-oriented construct for grouping logically related information objects, to include holdings other than technical publications.
Author
World Wide Web; Digital Techniques; Information Transfer

20040110342 NASA Langley Research Center, Hampton, VA, USA
Building a Multi-Discipline Digital Library Through Extending the Dienst Protocol
Nelson, Michael L.; Maly, Kurt; Shen, Stewart N. T.; [1997]; 2 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

The purpose of this project is to establish multi-discipline capability for a unified, canonical digital library service for scientific and technical information (STI). This is accomplished by extending the Dienst Protocol to be aware of subject classification of a servers holdings. We propose a hierarchical, general, and extendible subject classification that can encapsulate existing classification systems.
Author
Libraries; Protocol (Computers); Classifications; Data Management

20040110390 NASA Langley Research Center, Hampton, VA, USA
Integrating Information Technologies Into Large Organizations
Gottlich, Gretchen; Meyer, John M.; Nelson, Michael L.; Bianco, David J.; [1997]; 26 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

NASA Langley Research Center's product is aerospace research information. To this end, Langley uses information technology tools in three distinct ways. First, information technology tools are used in the production of information via computation, analysis, data collection and reduction. Second, information technology tools assist in streamlining business processes, particularly those that are primarily communication based. By applying these information tools to administrative activities, Langley spends fewer resources on managing itself and can allocate more resources for research. Third, Langley uses information technology tools to disseminate its aerospace research information, resulting in faster turn around time from the laboratory to the end-customer.
Derived from text
Computation; Information Systems; Streamlining

20040110487 Hi-Q Systems Ltd., Winchester
Working Towards Information Superiority: Application Coherence for Digitisation Programmes - A Method for Coherently Defining Requirements for Future Command and Control Information Systems
VAN Haperen, Kees; Dec. 2003; 41 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425306; No Copyright; Avail: CASI; A03, Hardcopy

Within the UK, a conceptual model has been developed which represents the main processes of the Army, i.e. the Army Activity Model (AAM). It predominantly illustrates information dependencies between processes and information elements that are exchanged between them. Over the last 18 months, the AAM has significantly matured. Moreover, there is a better understanding of its relevance for current and future Information Systems. A methodology has recently been developed that enables the richness of the AAM to be exploited for developing new C2 Information Systems (IS). By using this methodology coherent development and definition of user requirements can be achieved. In addition, the methodology enables, albeit at a high level, the assessment of coherence between C2IS and, more specifically, the processes and information that these systems support. Using UK Case Study based on the development of Joint Fire Support (JFS) Battlefield Information System Application (BISA), it is explained how the methodology allows the use of the AAM for development of new CCIS. It is explained various Soft Systems Methodology (SSM) and Modelling techniques helped to relate the JFS BISA to the AAM and define or validate coherent user requirements. Using the AAM, application coherence can be assessed and visualized at both informatics as well as technology levels. Although such assessments are conducted at a high level, they nevertheless provide detailed information on gaps and overlaps in the definition of IS requirements. This information could be used to improve requirements definition and aid coherent and interoperable system development. Finally, they will attempt to contrast the application coherence method with the COBP.
DTIC
Collection; Command and Control; Information Systems

20040110497 Air Force Inst. of Tech., Wright-Patterson AFB, OH
Organizing to Exploit the Information Domain: A Content Analysis of the Transformation Literature
Schug, Todd S.; Mar. 2004; 68 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425334; AFIT/GIR/ENV/04M-21; No Copyright; Avail: CASI; A04, Hardcopy

The US Department of Defense (DoD) has embarked on an ambitious plan to transform itself. A driving force behind this transformation is a realization that society has moved into an information age and that information age warfare will be significantly different from anything that has gone before it. At the heart of the transformation effort is a concept known as Network Centric Warfare (NCW). Transformation, information age warfare, and NCW all depend heavily on how the DoD handles the information domain. Although there are many organization structure/design issues that will derive from the transformation imperatives, one of central concerns is the need to alter the Information Technology (IT) functions/ organizations that are the vanguard of this effort. Given this background, this research attempted to answer the question What does the military transformation literature say about how the DoD should organize to exploit the information domain? Specifically, this research focused on ideas regarding organizing the IT organizations/functions of the DoD. Overall, the results showed that a majority of the transformation literature supports organizing the IT function to act as a service provider. The IT function would therefore act as a separate entity within the enterprise and would provide domain expertise to other parts

of the enterprise. Further research is required to determine if this type of organizational structure is applicable across the entire spectrum of the information domain.
DTIC
Defense Program; Information

20040110523 Defense Acquisition Univ., Fort Belvoir, VA
Defense AR Journal. Volume 11, Number 1, January- April 2004
Morell, Jonathan A.; Alford, Lionel D.; Rogers, Edward W.; Birmingham, Robert P.; Driessnack, John D.; Apr. 2004; 127 pp.; In English
Report No.(s): AD-A425470; No Copyright; Avail: CASI; A07, Hardcopy

The primary goal of the Acquisition Review Quarterly (ARQ) is to provide practicing DoD Acquisition, Technology and Logistic Professionals with relevant management tools and information based on recent advances in policy, management theory, and research. The ARQ addresses the needs of professionals across the full spectrum of defense acquisition, and is intended to serve as a mechanism for fostering and diseminating scholarly research on acquisition issues, for exchanging opinions, for communicating policy decision, and for maintaining a high level of awareness regarding acquisition management philosophies.
DTIC
Logistics Management; Procurement

20040110524 Defense Acquisition Univ., Fort Belvoir, VA
Acquisition Review Quarterly (ARQ): Volume 10, Number 1, Winter 2003
Sylvester, Richard K.; Ferrara, Joseph A.; Sherman, J. D.; Molzahn, Wendy; Gould III, Jay W.; Jan. 2003; 111 pp.; In English
Report No.(s): AD-A425471; No Copyright; Avail: CASI; A06, Hardcopy

The primary goal of the Acquisition Review Quarterly (ARQ) is to provide practicing DoD Acquisition, Technology and Logistic Professionals with relevant management tools and information based on recent advances in policy, management theory, and research. The ARQ addresses the needs of professionals across the full spectrum of defense acquisition, and is intended to serve as a mechanism for fostering and diseminating scholarly research on acquisition issues, for exchanging opinions, for communicating policy decision, and for maintaining a high level of awareness regarding acquisition management philosophies. Table of contents includes: Conflict and Ambiguity: Implementing Evolutionary Acquisition, Patriot PAC-2 Devleopment and deployment in the Gulf War, The CIA's In-Q.Tel Modal: Its Applicability, Program Planning of Asynchronous on-line Courses, Managing the development of Technology-Based Courses.
DTIC
Logistics Management; Military Personnel; Winter

20040110531 Defense Acquisition Univ., Fort Belvoir, VA
Defense AT&L: A Publication of the Defense Acquisition University. Unique Identification (UID) - A DoD Business Imperative. Volume 33, Number 1, January-February 2004
Wynn, Michael; Cavoli, Christina; Kaarlela, Mitch; Crosby, William T.; Saufter, Fred C.; Feb. 2004; 84 pp.; In English; Original contains color illustrations
Report No.(s): AD-A425527; No Copyright; Avail: CASI; A05, Hardcopy

Defense AT&L magazine is a vehicle for transmitting information on policies, trends, events, and current thinking affecting program management and defense acquisition, technology and logistics. As the flagship publication of the Defense Acquisition University, Defense AT&L also disseminates information on training and education, continuous learning, and e-Learning to those acquisition professionals serving in career positions covered by the Defense Acquisition Workforce Improvement Act (DAWIA).
DTIC
Commerce; Data Acquisition; Logistics Management

20040110706 Commerce Energy NASA NLM Defense Information Cataloging Committee, Washington, DC, USA, Department of Energy, Washington, DC, USA, Defense Technical Information Center, Fort Belvoir, VA, USA
CENDI Cost Study: The Changing R&D Information Economy in the Digital Age
Ubell, R.; Dec. 1997; 18 pp.; In English
Report No.(s): PB2004-107237; CENDI/97-3; No Copyright; Avail: CASI; A03, Hardcopy

This paper offers the following key judgements: (1) Since the Electronic Revolution is in its infancy, experts in the industry cannot predict the long-term effects. With little serious substantiated economic experience or cost studies, there is no current consensus about the consequences of introducing digital technologies. Many recognize that for the immediate future, a dual systemconventional print coupled with new electronic services--may be required. In this environment, costs in the short term are likely to increase. (2) The real payoff from the Electronic Revolution may not be economic. Rather, the investment may be returned in the creation of more effective products designed to generate quality decisions more rapidly. As a corollary, there is broad agreement that as the price per published unit of information declines, costs of delivering more value-added, personalized products to larger populations of end-users will cause costs to rise overall. Ever since the introduction of digital technologies, conventional wisdom imagined that the combined costs of acquiring, storing, retrieving and disseminating R&D documents would decline when compared with costs associated with delivering conventional print products.
NTIS
Digital Systems; Information Management; Electronic Publishing; Costs; Research and Development

20040110709 Information International Associates, Inc., Oak Ridge, TN, USA
CENDI Digital Library Initiatives: Toward a Digital Future
Hodge, G.; Oct. 1998; 36 pp.; In English
Report No.(s): PB2004-107228; CENDI/1998-4; No Copyright; Avail: CASI; A03, Hardcopy

At the February 1998 CENDI Meeting, the CENDI members approved a proposal by the CENDI Information Exchange Working Group to review the projects and plans related to the development of digital libraries among the agencies. The information gathering meeting was held on June 30, 1998 with eight of the nine CENDI agencies in attendance. The agencies have different definitions of digital libraries. In some cases, the libraries are strictly digital versions of textual material that was previously dealt with on paper. In other cases, the emphasis is on a virtual library, which is a homepage organized to link to a variety of collections. In several cases, the agencies were providing both digital libraries of their own science and technology materials, and creating virtual libraries based on information from other sources ranging from other federal agencies, to academia, to international organizations, to industry.
NTIS
Digital Systems; Libraries

20040110740 NASA Langley Research Center, Hampton, VA, USA
NASA Indexing Benchmarks: Evaluating Text Search Engines
Esler, Sandra L.; Nelson, Michael L.; Journal of Network and Computer Applications; October 1997; Volume 20, No. 4, pp. 339-353; In English; Copyright; Avail: CASI; A03, Hardcopy

The current proliferation of on-line information resources underscores the requirement for the ability to index collections of information and search and retrieve them in a convenient manner. This study develops criteria for analytically comparing the index and search engines and presents results for a number of freely available search engines. A product of this research is a toolkit capable of automatically indexing, searching, and extracting performance statistics from each of the focused search engines. This toolkit is highly configurable and has the ability to run these benchmark tests against other engines as well. Results demonstrate that the tested search engines can be grouped into two levels. Level one engines are efficient on small to medium sized data collections, but show weaknesses when used for collections 100MB or larger. Level two search engines are recommended for data collections up to and beyond 100MB.
Author
Indexing (Information Science); Texts

20040110803 NASA Langley Research Center, Hampton, VA
Aerospace Medicine and Biology: A Continuing Bibliography With Indexes
Oct. 20, 1997; 36 pp.; In English
Report No.(s): AD-A424463; NASA-SP-7011(450); No Copyright; Avail: CASI; A03, Hardcopy

This issue of Aerospace Medicine and Biology, A Continuing Bibliography with Indexes NASA SP-7O11 lists reports, articles, and other documents recently announced in the NASA STI Database. In its subject coverage, Aerospace Medicine and Biology concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate

attention. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.
DTIC
Aerospace Medicine; Bibliographies

20040111000 Research and Technology Organization, Neuilly-sur-Seine, France
All Electric Combat Vehicles (AECV) for Future Applications
July 2004; 234 pp.; In English
Report No.(s): RTO-TR-AVT-047; AC/323(AVT-047)TP/61; Copyright; Avail: CASI; C01, CD-ROM; A11, Hardcopy
Based on preceding studies of the last 10 years new electric technologies, technology requirements, systems for mobility, survivability and lethality of All Electric Combat Vehicles (AECV) were analysed, including pulse power requirement and energy storage. Enabling technologies were identified and potential payoffs were balanced against technical issues. A vehicle demonstration was performed. The general result is that further developing electric vehicle drives will be of advantage. The study dealt in detail with: Requirements. Mobility. Lethality and Survivability. Modelling and Simulation. Power Generation, Management & Distribution. Performance. Standardization and Dual Use. Life Cycle Cost of AECV.
Author
Combat; Electric Motor Vehicles; Energy Storage; Lethality

20040111002 Prins Maurits Lab. TNO, Rijswijk, Netherlands
The Impending USA-NL Project Arrangement on Modelling and Analyzing 'Combined Arms Dismounted Combatant Operations': Marking New Collaboration Opportunities
vanSon-deWaard, E. N.; Verhagen, Th. L. A.; January 2004; 18 pp.; In English
Contract(s)/Grant(s): A04/KL/4UG; TNO Proj. 014.16098
Report No.(s): TD2004-0014; PML-2004-A14; Copyright; Avail: Other Sources
This report documents the outcome of a bi-lateral meeting held from January 26 -th up to January 3ff th 2004 between the USA of America and the Netherlands in the research area of close combat modelling & analysis. The parties concerned were the US - Natick Soldier Center (NSC), its contractor Science Technology Incorporation (STI) and TNO Defence Research. The main objectives of this bilateral meeting were: 1. Exchange of information and national viewpoints related to: - Visions and roadmaps for Close Combat Modelling & Analysis. - International collaboration opportunities. - Human Centric Modelling. 2. Setting up the Management Plan for the execution of the Project Arrangement .
Derived from text
Combat; Management Planning; Models

83
ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

20040111007 Physics and Electronics Lab. TNO, The Hague, Netherlands
Life Cycle Cost Calculations for PATRIOT Advanced Capability-3
Smit, M. C.; Verkoeijen, P. C. F. M.; Vierveijzer, P.; January 2004; 47 pp.; In Dutch
Contract(s)/Grant(s): TNO Proj. 015.30998/01.02
Report No.(s): FEL-O3-A205; TD03-0098; Copyright; Avail: Other Sources
This report describes a Life Cycle Cost (LCC) Study performed by TNO-FEL to support the RNLAF (D M W P G) in the DMP-B/C/D phase of the procurement of the PATRIOT Advanced Capability - 3. TNO-FEL used the FEL-SALDO methodology to determine the LCC. The results of this study are an LCC-model and a cost breakdown structure. For each relevant cost element in this structure the costs have been determined. Furthermore a sensitivity analysis has been conducted on some important or uncertain parameters.
Author
Cost Analysis; Life Cycle Costs; Free Electron Lasers

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LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes aviation law; space law and policy; international law; international cooperation; and patent policy.

20040110246 NASA Langley Research Center, Hampton, VA, USA
Commercialization of the Space Frontier
Piland, William M.; [1997]; 12 pp.; In English; 48th International Astronautical Congress, 6-10 Oct. 1997, Turin, Italy
Report No.(s): IAF-97-IAA.1.3.01; No Copyright; Avail: CASI; A03, Hardcopy

This paper discusses the current outlook for space business, how growing space business will improve the quality of life for all, and identified strategies for better relating international space research, technology, and space system operations to commercial interests in space. By drawing on recent assessments of the future potential for business in space, opportunities will be defined for encouraging the growth of business uses of space and regaining the public's awareness and support for expanding the space frontier.
Author
Aerospace Industry; Space Commercialization; Aerospace Technology Transfer; Space Programs; Government/Industry Relations

85
TECHNOLOGY UTILIZATION AND SURFACE TRANSPORTATION

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see also *03 Air Transportation and Safety, 16 Space Transportation and Safety*, and *44 Energy Production and Conversion*. For specific technology transfer applications see also the category where the subject is treated.

20040110667 NASA Langley Research Center, Hampton, VA, USA
Detection of Ocean Reflected GPS Signals: Theory and Experiment
Garrison, James L.; Katzberg, Stephen J.; Howell, Charles T., III; [1997]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A number of advanced applications of the Global Positioning System (GPS) have been proposed which use the signal reflected from a smooth ocean surface. The viability of these concepts hinges upon the ability to acquire and code track the reflected signal for an extended period of time over a variety of sea states. The analytical theory of specularly and diffusely reflected radio frequency radiation from a rough surface is reviewed. Experiments to demonstrate tracking of a reflected signal were performed on three aircraft flights over the Chesapeake Bay and the Eastern Shore of Virginia. The experimental hardware consisted of two of-the-shelf receivers configured so that one received the GPS signal in the conventional manner using a right hand circularly polarized (RHCP) antenna on top of the fuselage and the other could receive the reflected signal using a left hand circularly polarized (LHCP) antenna on the bottom of the fuselage. Three tests were performed on the data to verify that the signals received in the bottom antenna were viewed as sea surface reflections; Pseudorange double differences were compared against predicted geometric range double differences; Characteristics of a signal reflected from a random surface were observed in the carrier to noise ratio; Predicted specular points were plotted which demonstrate reflection only from wet areas. These tests indicated tracking of reflected signals for extended periods of time at altitudes of up to 5500 m and sporadic signal acquisition at higher altitudes. The duration of the continuous signal tracking was limited by the receiver's need to maintain carrier tracking.
Author
Global Positioning System; Ocean Surface; Reflected Waves

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SPACE SCIENCES (GENERAL)

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

20040095901 Science Systems and Applications, Inc., Lanham, MD, USA, NASA Goddard Space Flight Center, Greenbelt, MD, USA
Wavefront Control Testbed (WCT) Experiment Results
Burns, Laura A.; Basinger, Scott A.; Campion, Scott D.; Faust, Jessica A.; Feinberg, Lee D.; Hayden, William L.; Lowman, Andrew E.; Ohara, Catherine M.; Petrone, Peter P., III, et al.; May 2004; 11 pp.; In English; SPIE Astronomical Telescopes Conference, 21-25 Jun. 2004, Glasgow, Scotland, UK; Copyright; Avail: CASI; A03, Hardcopy

The Wavefront Control Testbed (WCT) was created to develop and test wavefront sensing and control algorithms and software for the segmented James Webb Space Telescope (JWST). Last year, we changed the system configuration from three sparse aperture segments to a filled aperture with three pie shaped segments. With this upgrade we have performed experiments on fine phasing with line-of-sight and segment-to-segment jitter, dispersed fringe visibility and grism angle;. high dynamic range tilt sensing; coarse phasing with large aberrations, and sampled sub-aperture testing. This paper reviews the results of these experiments.
Author
James Webb Space Telescope; Wave Fronts; Spaceborne Telescopes; Dynamic Range; Visual Perception

20040110432 NASA Langley Research Center, Hampton, VA, USA
The Attached Payload Facility Program: A Family of In-Space Commercial Facilities for Technology, Science and Industry
Avery, Don E.; Kaszubowski, Martin J.; Kearney, Michael E.; Howard, Trevor P.; [1996]; 6 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

It is anticipated that as the utilization of space increases in both the government and commercial sec tors the re will be a high degree of interest in materials and coatings research as well as research in space environment definition, deployable structures, multi-functional structures and electronics. The International Space Station (ISS) is an excellent platform for long-term technology development because it provides large areas for external attached payloads, power and data capability, and ready access for experiment exchange and return. An alliance of SPACEHAB, MicroCraft, Inc. and SpaceTec, Inc. has been formed to satisfy this research need through commercial utilization of the capabilities of ISS. The alliance will provide a family of facilities designed to provide low-cost, reliable access to space for experimenters. This service would start as early as 1997 and mature to a fully functional attached facility on ISS by 2001. The alliances facilities are based on early activities by NASA, Langley Research Center (LaRC) to determine the feasibility of a Material Exposure Facility (MEF).
Author
Payloads; Aerospace Environments; Exposure; Landforms; Spacecraft Modules

20040110961 California Inst. of Tech., Pasadena, CA, USA
A Summer Research Program of NASA/Faculty Fellowships at the Jet Propulsion Laboratory
Albee, Arden; [2004]; 2 pp.; In English
Contract(s)/Grant(s): NAG5-11932; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Faculty Fellowship Program (NFFP) is designed to give college and university faculty members a rewarding personal as well as enriching professional experience. Fellowships are awarded to engineering and science faculty for work on collaborative research projects of mutual interest to the fellow and his or her JPL host colleague. The Jet Propulsion Laboratory (JPL) and the California Institute of Technology (Caltech) have participated in the NASA Faculty Fellowship Program for more than 25 years. Administrative offices are maintained both at the Caltech Campus and at JPL; however, most of the activity takes place at JPL. The Campus handles all fiscal matters. The duration of the program is ten continuous weeks. Fellows are required to conduct their research on-site. To be eligible to participate in the program, fellows must be a U.S. citizen and hold a teaching or research appointment at a U.S. university or college. The American Society of Engineering Education (ASEE) contracts with NASA and manages program recruitment. Over the past several years, we have made attempts to increase the diversity of the participants in the NFFP Program. A great deal of attention has been given to candidates from minority-serving institutions. There were approximately 100 applicants for the 34 positions in 2002. JPL was the first-choice location for more than half of them. Faculty from 16 minority-serving institutions participated as well as four women. The summer began with an orientation meeting that included introduction of key program personnel, and introduction of the fellows to each other. During this welcome, the fellows were briefed on their obligations to the program and to their JPL colleagues. They were also given a short historical perspective on JPL and its relationship to Caltech and NASA. All fellows received a package, which included information on administrative procedures, roster of fellows, seminar program, housing questionnaire, directions to JPL, maps of the local area, and a copy of the JPL Universe (a JPL newsletter). A calendar of events for the 2002 NFFP Program was designed to expose the fellows to the full range of JPL activities, seminars, tours, and trips to NASA Dryden, Goldstone, and Palomar Observatory. Weekly brown-bag lunches were also scheduled. The lunches provided a time for airing problems that may have arisen during the previous week, soliciting suggestions for program enhancement, announcements, and general socializing. Professor and Mrs. Albee also hosted the annual Summer Faculty Welcome Party at their home. During their ten-week tenure at JPL, the visiting faculty carried out projects in a wide variety of JPL's science, engineering, and technology disciplines, including communication, planetary science, materials research, reliability and quality assurance, astronomy, guidance and control, and micro-sensors. At the end of the NFFP Program, all

fellows were required to complete a one-page summary of their summer s work. This was in addition to any documentation required by their host organization. Distribution of the final paycheck was dependent upon submission of this one-page summary and completion of NASA's NFFP evaluation in the EdCATS system. Fellows were also asked to complete a questionnaire for JPL, which enables the program administrators to make any appropriate changes to make the program more beneficial and effective for all involved. The 2002 NFFP Program at JPUCaltech was considered unanimously highly successful by both fellows and JPL colleagues. It provided a significant experience to most faculty members and fresh ideas to JPL researchers. Each year, suggestions for improvement include expansion of the program, longer terms, larger stipends, funds to support graduate students, and funds to continue collaborative research. The NASA Faculty Fellowship Program continues to occupy a significant place in JPL programs and serves to strengthen the ties between NASA, JPL, Caltech, and t academic community. This program is an important part of NASA's commitment to education. No inventions or patents were created during this program.
Derived from text
Education; Research and Development; Summer; NASA Programs

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ASTRONOMY

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

20040105583 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Crustal Magnetic Spectra from Correlated Sources on Mars
Voorhies, Coerte V.; [2004]; 1 pp.; In English; Spring 2004 AGU Meeting, 17-21 May 2004, Montreal, Canada; No Copyright; Avail: Other Sources; Abstract Only

The spectral method for distinguishing crustal from core-source magnetic fields has been re-examined, modified and applied to both a comprehensive geomagnetic field model and an altitude normalized magnetic map of Mars. These observational spectra are fairly fitted by theoretical forms expected from certain elementary classes of magnetic sources. For Earth we found fields from a core radius 3512 +/- 64 km and a crust represented by a shell of random dipolar sources at radius 6367 +/- 14 km. For Mars we found only a field from a crust represented in the same way, but 46 +/- 10 km below the planetary menu radius. More realistic theoretical spectra, allowing for crustal thickness, oblateness and magnetization by a planet centered dipole, were derived and discussed, as were spectral effects of laterally correlated sources. The main effect of laterally correlated sources is to soften the spectrum at high degrees. We tend to over-estimate source shell depth when this is omitted. To include this effect simply size and magnetization distribution functions for extended sources are recast as a characteristic diameter and mean square magnetization amplitude for an ensemble of vertically magnetized spherical caps on a shell. For small caps, and at moderated degrees, the practical derivatives of the log-theoretical spectrum with respect to amplitude, shell radius, and cap diameter are approximately proportional to l, n, and -n **2, respectively. Separation of diameter from amplitude from layer thickness. Results from applications to observational spectra are discussed, noting that there are now several fine field models for Mars; moreover, the terrestrial magnetic spectrum at high degrees, as revised, updated with high precision Oerstad data, and upgrade with high resolution Champ data, appears softer than before.
Derived from text
Magnetic Spectroscopy; Crusts; Mars Surface; Radii

20040110223 Swales Aerospace, Silver Spring, MD, USA
Failure Investigation & Design Optimization of a Photo-Multiplier Tube Assembly Under Thermal Loading
Dahya, Kevin; [2004]; 17 pp.; In English; NASA/GSFC FEMCI Workshop, 5-6 May 2004, Greenbelt, MD, USA; No Copyright; Avail: CASI; A03, Hardcopy

Analysis of GLAST ACD Photo-Multiplier Tube (PMT) assembly under thermal loading demonstrates that the glass tube experiences high stresses due to Coefficient of Thermal Expansion mismatch, as well as increased stress due to high stiffness and incompressibility of potting compound. Further investigation shows adverse loading effects due to the magnetic shield, a thin piece of steel wrapped around the PMT. This steel, Mu Metal, contained an overlap region that directly attributed to crack propagation in the outside surface of the tube. Sensitivities to different configurations were studied to reduce the stress and provide a more uniform loading throughout the PMT to ensure mission success. Studies indicate substituting a softer and

more compressible potting compound and moving the Mu metal from the glass tube to the outside wall of the aluminum housing yields lower stress.
Author
Potting Compounds; Heat; Thermal Expansion; Steels; Crack Propagation; Telescopes; Vacuum Tubes; Metallic Glasses

20040110224 Colorado Univ., Boulder, CO, USA
Chromospheric Activity in Population II Giants
Harper, Graham M.; August 1, 2004; 2 pp.; In English
Contract(s)/Grant(s): NAG5-12210
Report No.(s): CU-1535515; No Copyright; Avail: CASI; A01, Hardcopy

One of the mysteries of Population II giants is that they still show chromospheric emission despite their great age. The global dynamo which was active during their main-sequence lifetimes is expected to become extremely weak through magnetic rotational braking. The nature of the observed emission is not understood; although acoustic shock waves might provide the heating, acoustic waves are not predicted to drive the observed mass loss - which in turn requires the dissipation of magneto-hydrodynamic waves. This program was designed to search for the faint stellar H Ly beta emission wings and the fluorescent Fe II and H2 emission from one of the brightest, metal poor, Population II stars. These FUSE diagnostics, when combined with existing UV and optical spectra, help determine the major radiative cooling channels for the chromosphere. This observation was to complement that previously planned for the mildly metal deficient giant alpha Boo (K2 III). However, alpha Boo has yet to be observed with FUSE.
Author (revised)
Chromosphere; Giant Stars; Population II Stars; Stellar Activity

20040110247 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Mission Concept for the Single Aperture Far-Infrared (SAFIR) Observatory
Benford, Dominic J.; Amato, Michael J.; Mather, John C.; Moseley, S. Harvey, Jr.; [2004]; 38 pp.; In English; Copyright; Avail: Other Sources

We have developed a preliminary but comprehensive mission concept for SAFIR, as a 10 m-class far-infrared and submillimeter observatory that would begin development later in this decade to meet the needs outlined above. Its operating temperature (\h or = 4K) and instrument complement would be optimized to reach the natural sky confusion limit in the far-infrared with diffraction-limited performance down to at least the atmospheric cutoff, lambda \g or approx. 40 microns. This would provide a point source sensitivity improvement of several orders of magnitude over that of the Spitzer Space Telescope (previously SIRTF) or the Herschel Space Observatory. Additionally, it would have an angular resolution 12 times finer than that of Spitzer and three times finer than Herschel. This sensitivity and angular resolution are necessary to perform imaging and spectroscopic studies of individual galaxies in the early universe. We have considered many aspects of the SAFIR mission, including the telescope technology (optical design, materials, and packaging), detector needs and technologies, cooling method and required technology developments, attitude and pointing, power systems, launch vehicle, and mission operations. The most challenging requirements for this mission are operating temperature and aperture size of the telescope, and the development of detector arrays. SAFIR can take advantage of much of the technology under development for JWST, but with much less stringent requirements on optical accuracy.
Author
Infrared Astronomy; Infrared Telescopes; Spaceborne Telescopes; Mission Planning

20040110248 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A Multi-Wavelength Search for a Counterpart of the Unidentified Gamma-ray source 3EG J2020+4017 (2CG078+2)
Becker, Werner; Weisskopf, Martin C.; Arzoumanian, Zaven; Lorimer, Duncan; Camilo, Fernando; Elsner, Ronald F.; Kanbach, Gottfried; Reimer, Olaf; Swartz, Douglas A.; Tennant, Allyn F., et al.; [2004]; 33 pp.; In English
Contract(s)/Grant(s): NRA-99-01-LTSA-070; NSF AST-02-05853; No Copyright; Avail: CASI; A03, Hardcopy

In search of the counterpart to the brightest unidentified gamma-ray source 3EG J2020+4017 (2CG078+2) we report on new X-ray and radio observations of the gamma-Cygni field with the Chandra X-ray Observatory and with the Green Bank Telescope (GBT). We also report on reanalysis of archival ROSAT data. With Chandra it became possible for the first time to measure the position of the putative gamma-ray counterpart RX J2020.2+4026 with sub-arcsec accuracy and to deduce its X-ray spectral characteristics. These observations demonstrate that RX J2020.2+4026 is associated with a K field star and therefore is unlikely to be the counterpart of the bright gamma-ray source 2CG078+2 in the SNR G78.2+2.1 as had been

previously suggested. The Chandra observation detected 37 additional X-ray sources which were correlated with catalogs of optical and infrared data. Subsequent GBT radio observations covered the complete 99% EGRET likelihood contour of 3EG J2020+4017 with a sensitivity limit of L(sub 820) approx. 0.1 mJy kpc(exp 2) which is lower than most of the recent deep radio search limits. If there is a pulsar operating in 3EG J2020+4017, this sensitivity limit suggests that the pulsar either does not produce significant amounts of radio emission or that its geometry is such that the radio beam does not intersect with the line of sight. Finally, reanalysis of archival ROSAT data leads to a flux upper limit of f(sub x)(0.1-2.4 keV) \h 1.8 x 10(exp -13) erg/s/sq cm for a putative point-like X-ray source located within the 68% confidence contour of 3EG J2020+4017. Adopting the SNR age of 5400 yrs and assuming a spin-down to X-ray energy conversion factor of 10(exp -3) this upper limit constraints the parameters of a putative neutron star as a counterpart for 3EG J2020+4017 to be P \g or approx. 160/(d/1.5 kpc) ms, P \g or approx. 5 x 10(exp -13)/(d/1.5kpc) s s1 and B \g or approx. 9 x 10(exp 12)/(d/1.5 kpc) G.
Author
Gamma Ray Sources (Astronomy); X Ray Astronomy; Radio Observation

20040110275 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Wavefront Sensing Using a Multi-Object Spectrograph (NIRSpec)
Dean, Bruce H.; Boucarut, Rene; Hadjimichael, Theo; Smith, Scott; [2004]; 16 pp.; In English; SPIE Conference, 19-25 Jun. 2004, Glasgow, Scotland, UK; No Copyright; Avail: CASI; A03, Hardcopy

An analysis is presented that illustrates how the James Webb Space Telescope (JWST) fine-phasing process can be carried out using the Near-Infrared Spectrograph (NIRSpec) data collected at the science focal plane. The analysis considers a multi-plane diffraction model which properly accounts for the microshutter diffractive element placed at the first relay position of the spectrograph. Wavefront sensing results are presented based on data collected from the NASA Goddard Microshutter Testbed.
Author
Spectrographs; Wave Fronts; James Webb Space Telescope; Mirrors; Image Processing; Microelectromechanical Systems

20040110480 Industrial Coll. of the Armed Forces, Washington, DC
Space Industry Study Industrial College of the Armed Forces National Defense University
Blalock, Carolyn; Busby, Steven; Chapman, William; Evans, Martha; Helton, Emory; Jun. 2002; 24 pp.; In English
Report No.(s): AD-A425286; No Copyright; Avail: CASI; A03, Hardcopy

The USA has no current peer in outer space. However, past and present preeminence in space does not guarantee success in the future. Over the past three years, the ICAF Space Industry Study has followed the decline in the industry from the bubble of optimism so prominent in the late 1990s. The collapse of the market for low earth orbit (LEO) telecommunications satellites was followed by a slump in the more traditional geosynchronous (GEO) systems that is projected to continue until the second half of this decade. In this new environment, the whole range of assumptions and policies governing the relationship of the commercial and government sectors require reassessment. Broadly speaking, the government sector has reassumed its traditional role as critical anchor tenant for the industry. The events of the past year the attack on America and the war that has followed have reinforced that trend, both by calling more attention to military space requirements, and by further chilling the commercial space sector.
DTIC
Armed Forces; Defense Program; Industries; Space Transportation; Universities; Warfare

20040110690 NASA Goddard Space Flight Center, Greenbelt, MD, USA
An Expanded RXTE Survey of Long-Term X-ray Variability in Seyfert 1 Galaxies
Markowitz, A.; Edelson, R.; [2004]; 30 pp.; In English
Contract(s)/Grant(s): NAG5-7385; NAG5-7067; No Copyright; Avail: CASI; A03, Hardcopy

The first seven years of RXTE monitoring of Seyfert 1 active galactic nuclei have been systematically analyzed to yield five homogenous samples of 2-12 keV light curves, probing hard X-ray variability on successively longer durations from approx. 1 day to approx. 3.5 years. 2-10 keV variability on time scales of approx. 1 day, as probed by ASCA, are included. All sources exhibit stronger X-ray variability towards longer time scales, with variability amplitudes saturating at the longest time scales, but the increase is greater for relatively higher luminosity sources. The well-documented anticorrelation between variability amplitude and luminosity is confirmed on all time scales. However, anticorrelations between variability amplitude and black hole mass estimate are evident on only the shortest time scales probed. The data are consistent with the models of power spectral density (PSD) movement described in Markowitz et al. (2003) and McHardy et al. (2004), whereby Seyfert

1 galaxies variability can be described by a single, universal PSD shape whose cutoff frequency scales with black hole mass. The best-fitting scaling relations between variability time scale, black hole mass and X-ray luminosity support an average accretion rate of 2% of the Eddington limit for the sample. Nearly all sources exhibit stronger variability in the relatively soft 2-4 keV band compared to the 7-12 keV band on all time scales. Color-flux diagrams support also Seyfert 1s' softening as they brighten. There are indications that relatively less luminous or less massive sources exhibit a greater degree of spectral variability for a given increase in overall flux.
Author
X Ray Astronomy; Seyfert Galaxies; Active Galactic Nuclei; Variability

20040110695 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Generation-X X-ray Observatory Vision Mission and Technology Study
Figueroa-Feliciano, Enectali; [2004]; 2 pp.; In English; Beyong Einstein, 12-14 May 2004, Stanford, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

The new frontier in astrophysics is the study of the birth and evolution of the first stars, galaxies and black holes in the early Universe. X-ray astronomy opens a window into these objects by studying the emission from black holes, supernova explosions and the gamma-ray burst afterglows of massive stars. However, such objects are beyond the grasp of current or near-future observatories. X-ray imaging and spectroscopy of such distant objects will require an X-ray telescope with large collecting area and high angular resolution. Our team has conceived the Generation-X Vision Mission based on an X-ray observatory with 100 sq m collecting area at 1 keV (1000 times larger than Chandra) and 0.1 arcsecond angular resolution (several times better than Chandra and 50 times better than the Constellation-X resolution goal). Such an observatory would be capable of detecting the earliest black holes and galaxies in the Universe, and will also study extremes of density, gravity, magnetic fields, and kinetic energy which cannot be created in laboratories. NASA has selected the Generation-X mission for study under its Vision Mission Program. We describe the studies being performed to develop the mission concept and define candidate technologies and performance requirements for Generation-X. The baseline Generation-X mission involves four 8m diameter X-ray telescopes operating at Sun-Earth L2. We trade against an alternate concept of a single 26m diameter telescope with focal plane instruments on a separate spacecraft. A telescope of this size will require either robotic or human-assisted in-flight assembly. The required effective area implies that extremely lightweight grazing incidence X-ray optics must be developed. To achieve the required aerial density of at least 100 times lower than in Chandra, we will study 0.1mm thick mirrors which have active on-orbit figure control. We discuss the suite of required detectors, including a large FOV high angular resolution imager, a cryogenic imaging spectrometer and a grating spectrometer. We outline the development roadmap to confront the many technological challenges far implementing the Generation-X mission.
Author
X Ray Astronomy; X Ray Telescopes; Large Space Structures; Feasibility Analysis

20040110872 NASA Goddard Space Flight Center, Greenbelt, MD, USA
MGGPOD: a Monte Carlo Suite for Modeling Instrumental Line and Continuum Backgrounds in Gamma-Ray Astronomy
Weidenspointner, G.; Harris, M. J.; Sturner, S.; Teegarden, B. J.; Ferguson, C.; [2004]; 51 pp.; In English; Copyright; Avail: CASI; A04, Hardcopy

Intense and complex instrumental backgrounds, against which the much smaller signals from celestial sources have to be discerned, are a notorious problem for low and intermediate energy gamma-ray astronomy (approximately 50 keV - 10 MeV). Therefore a detailed qualitative and quantitative understanding of instrumental line and continuum backgrounds is crucial for most stages of gamma-ray astronomy missions, ranging from the design and development of new instrumentation through performance prediction to data reduction. We have developed MGGPOD, a user-friendly suite of Monte Carlo codes built around the widely used GEANT (Version 3.21) package, to simulate ab initio the physical processes relevant for the production of instrumental backgrounds. These include the build-up and delayed decay of radioactive isotopes as well as the prompt de-excitation of excited nuclei, both of which give rise to a plethora of instrumental gamma-ray background lines in addition t o continuum backgrounds. The MGGPOD package and documentation are publicly available for download. We demonstrate the capabilities of the MGGPOD suite by modeling high resolution gamma-ray spectra recorded by the Transient Gamma-Ray Spectrometer (TGRS) on board Wind during 1995. The TGRS is a Ge spectrometer operating in the 40 keV to 8 MeV range. Due to its fine energy resolution, these spectra reveal the complex instrumental background in formidable detail, particularly the many prompt and delayed gamma-ray lines. We evaluate the successes and failures of the MGGPOD package

in reproducing TGRS data, and provide identifications for the numerous instrumental lines.
Author
Gamma Ray Astronomy; Monte Carlo Method; Computer Programs; Line Spectra; Continuum Modeling

20040110873 National Optical Astronomy Observatories, Tucson, AZ, USA, National Solar Observatory, Tucson, AZ, USA
NOAO/NSO Newsletter, No. 79
Isbell, Douglas, Editor; Najita, Joan, Editor; Bell, Dave, Editor; Hartman, Mia, Editor; vanderBlick, Nicole S., Editor; Green, Richard, Editor; Hinkle, Ken, Editor; Adams, Sally, Editor; Leibacher, John, Editor; Piano, Priscilla, Editor, et al.; September 2004; 50 pp.; In English; Copyright; Avail: Other Sources

The sections in this issue of the National Optical Astronomy Observatory/National Solar Observatory (NOAO/NSO) Newsletter cover: 1) Science Highlights; 2) Director's Office; 3) NOAO Gemini Science Center; 4) Observational Programs; 5) Cerro Tololo Inter-American Observatory; 6) Kitt Peak National Observatory; 7) National Solar Observatory/GONG; 8) Public Affairs and Educational Outreach.
Derived from text
Astronomical Observatories; Solar Observatories

90
ASTROPHYSICS

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

20040105570 NASA Goddard Space Flight Center, Greenbelt, MD, USA
GRB 021211 as a Faint Analogue of GRB 990123: Exploring the Similarities and Differences in the Optical Afterglows
Holland, Stephen T.; Bersier, David; Bloom, J. S.; Garnavich, Peter M.; Caldwell, Nelson; Challis, Peter; Kirshner, Robert; Luhman, Kevin; McLeod, Brian; Stanek, K. Z.; [2004]; 25 pp.; In English
Contract(s)/Grant(s): NAG5-9364; Copyright; Avail: CASI; A03, Hardcopy

We present BVR(sub c)JHK(sub s) photometry of the optical afterglow of the gamma-ray burst GRB 021211 taken at the Magellan, MMT, and WIYN observatories between 0.7 and 50 days after the burst. We find an intrinsic spectral slope at optical and near-infrared wavelengths of 0.69 +/- 0.14 at 0.87 days. The optical decay during the first day is almost identical to that of GRB 990123 except that GRB 021211's optical afterglow was intrinsically approximately 38 times fainter and the transition from the reverse shock to the forward shock may have occurred earlier than it did for GRB 990123. We find no evidence for a jet break or the cooling break passing through optical frequencies during the first day after the burst. There is weak evidence for a break in the J-band decay between 0.89 and 1.87 days which may be due to a jet. The optical and infrared data are consistent with a relativistic fireball where the shocked electrons are in the slow cooling regime and the electron index is 2.3 +/- 0.1. The burst appears to have occurred in a homogeneous ambient medium. Our analysis suggests that the jet of GRB 021211 may have a small opening angle (1.4 deg-4.4 deg) and that the total gamma-ray energy is much less than the canonical value of 1.33 x 10(exp 51) erg. If, this is the case then most of the energy of the burst may be in another form such as a frozen magnetic field, in supernova ejecta, or in a second jet component. The host galaxy of GRB 021211 is subluminous and has a star formation rate of at least 1 solar mass/yr.
Author
Gamma Ray Astronomy; Gamma Ray Bursts; Afterglows

20040105664 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Oscillations and Stability of Differentially Rotating Neutron Stars
Watts, A.; [2004]; 1 pp.; In English; GR17 International Conference on General Relativity and Gravitation, 18-23 Jul. 2004, Dublin, Ireland, UK; No Copyright; Avail: Other Sources; Abstract Only

Studies of the oscillations and stability of neutron stars are motivated by the fact that vibrating neutron stars are a promising source of gravitational waves. One important factor is the influence of differential rotation, which is likely to arise in a neutron star at times, such as the immediate aftermath of the supernova, when we expect strong vibrations. I will discuss two phenomena unique to differentially rotating systems: dynamical shear instabilities, and the existence of a co-rotation band (a frequency band in which mode pattern speed matches the local angular velocity). Using a simple model, we have found dynamical shear instabilities that arise where modes cross into the co-rotation band, if the degree of differential rotation exceeds a certain threshold. We are currently investigating whether this mechanism operates in more realistic stellar models, and whether it is responsible for the dynamical instabilities occurring at low ratios of kinetic to potential energy that have been

observed by several authors. I will present the latest results of these studies. Another topic of investigation is the nature of oscillations within the co-rotation band. The band gives rise to a continuous spectrum whose collective physical perturbation exhibits complicated temporal behaviour. I will also discuss the existence of modes within the continuous spectrum that appear physically indistinguishable from the discrete modes outside the band, despite the apparently singular nature of their eigenfunctions.
Author
Stellar Rotation; Neutron Stars; Oscillations

20040110261 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Neutron Star Structure In The Presence of Scalar Fields
Crawford, James P.; Kazanas, Demosthenes; [2004]; 1 pp.; In English; Beyond Einstein Conference, 12-15 May 2004, Stanford, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

Motivated by the possible presence of scalar fields on astrophysical scales, suggested by the recent measurement of the deceleration parameter by supernovae surveys, we present models of neutron star structure under the assumption that a scalar field makes a significant contribution to the stress energy momentum tensor, in addition to that made by the normal matter. To that end we solve the coupled Einstein - scalar field - hydrostatic balance equations to compute the effect of the presence of the scalar field on the neutron star structure. We find that the presence of the scalar field does change the structure of the neutron star, especially in cases of strong coupling between the scalar field and the matter density. We present the neutron star radius as a function of the matter-scalar field coupling constant for different values of the neutron star central density. The presence of the scalar field does affect both the maximum neutron star mass and its radius, the latter increasing with the value of the above coupling constant. Our results may be testable with the recent timing observations of accreting neutron stars.
Author
Astrophysics; Neutron Stars; Scalars; Stellar Models; Stellar Structure

20040110270 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Properties and the Evolution of the Highly Ionized Gas in MR 2251-178
Kaspi, Shai; Netzer, hagai; Chelouche, Doron; George, Ian M.; Nandra, Kirpal; Turner, T. J.; [2004]; 14 pp.; In English
Contract(s)/Grant(s): NAG5-7385; NAG5-7067; ISF-545/00; Copyright; Avail: CASI; A03, Hardcopy

We present the first XMM-Newton observations of the radio-quiet quasar MR 2251-178 obtained in 2000 and 2002. The EPIC-pn spectra show a power-law continuum with a slope of Gamma = 1.6 at high energies absorbed by at least two warm absorbers (WAs) intrinsic to the source. The underlying continuum in the earlier observation shows a soft excess at low X-ray energies which can be modeled as an additional power-law with Gamma = 2.9. The spectra also show a weak narrow iron K alpha emission line. The high-resolution grating spectrum obtained in 2002 shows emission lines from N VI, O VII, O VIII, Ne IX, and Ne X, as well as absorption lines from the low-ionization ions of O III, O IV, and O V, and other confirmed and suspected weaker absorption lines. The O III - O V lines are consistent with the properties of the emission line gas observed as extended optical (O III) emission in this source. The signal-to-noise of the 2000 grating data is too low to detect any lines. We suggest a model for the high-resolution spectrum which consist of two or three warm-absorber (WA) components. The two-components model has a high-ionization WA with a column density of 10(exp 21.5)-10 (exp 21.8) sq cm and a low-ionization absorber with a column density of 10(exp 20.3) sq cm. In the three-components model we add a lower ionization component that produces the observed iron M-shell absorption lines. We investigate the spectral variations in MR 2251-178 over a period of 8.5 years using data from ASCA, BeppoSAX, and XMM-Newton. All X-ray observations can be fitted with the above two power laws and the two absorbers. The observed luminosity variations seems to correlate with variations in the soft X-ray continuum. The 8.5 year history of the source suggests a changing X-ray absorber due to material that enters and disappears from the line-of-sight on timescales of several months. We also present, for the first time, the entire FUSE spectrum of MR 2251-178. We detect emission from N III, C III, and O VI and at least 4 absorption systems in C III, H I, and O VI, one at -580 km/s and at least 3 others which are blended together and form a wide trough covering the velocity range of 0 to -500 km/s. The general characteristics of the UV and X-ray absorbers are consistent with an origin in the same gas.
Author
X Ray Astronomy; Quasars; Active Galactic Nuclei; Ionized Gases

20040110302 Space Telescope Science Inst., Baltimore, MD, USA
Multiwavelength Photometric Imaging of X-Ray and EUV Emission from Comet P/Tempel-Tuttle 1998
Lisse, Carey M.; July 23, 2004; 2 pp.; In English
Contract(s)/Grant(s): NAG5-8846; STScI Proj. J0229; Copyright; Avail: Other Sources

The unexpected discovery of x-ray emission from Comet Hyakutake in March 1996 (Lisse et ai. 1996) has produced a number of questions about the physical mechanism producing the radiation. The original detection and subsequent observations (Dennerl et ai. 1997, Mumma et al. 1997, Krasnopolsky et al. 1998, Owens et al. 1998. Lisse et al. 1999) have shown that the very soft (best fit thermal bremsstrahlung model kT approx. 0.2 keV) emission is due to an interaction between the solar wind and the comet's atmosphere. Using the results fiom the 15 comets detected to date in x-rays, we report on the latest results on cometary x-ray emission, including new results from Chandra and XMM. As-observed morphologies, spectra, and light curves will be discussed. Our emphasis will be on understanding the physical mechanism producing the emission, and using this to determine the nature of the cometary coma, the structure of the solar wind in the heliosphere, and the source of the local soft x-ray background. This work has been graciously supported by grants from the NASA Planetary Astronomy and Astrophysical Data Programs.
Author
Solar Wind; X Rays; Emission; Cometary Atmospheres; Background Radiation; Comets

20040110376 NASA Langley Research Center, Hampton, VA, USA
Earth Radiation Budget Experiment (ERBE) Data Sets for Global Environment and Climate Change Studies
Bess, T. Dale; Carlson, Ann B.; Denn, Fredrick M.; [1997]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

For a number of years there has been considerable interest in the earth's radiation budget (ERB) or energy balance, and entails making the best measurements possible of absorbed solar radiation, reflected shortwave radiation (RSW), thermal outgoing longwave radiation (OLR), and net radiation. ERB data are fundamental to the development of realistic climate models and studying natural and anthropogenic perturbations of the climate. Much of the interest and investigations in the earth's energy balance predated the age of earth-orbiting satellites (Hunt et al., 1986). Beginning in the mid 1960's earth-orbiting satellites began to play an important role in making measurements of the earth's radiation flux although much effort had gone into measuring ERB parameters prior to 1960 (House et al., 1986). Beginning in 1974 and extending until the present time, three different satellite experiments (not all operating at the same time) have been making radiation budget measurements almost continually in time. Two of the experiments were totally dedicated to making radiation budget measurements of the earth, and the other experiment flown on NOAA sun-synchronous AVHRR weather satellites produced radiation budget parameters as a by-product. The heat budget data from the AVHRR satellites began collecting data in June 1974 and have operated almost continuously for 23 years producing valuable data for long term climate monitoring.
Derived from text
Earth Radiation Budget Experiment; Data Acquisition; Climate Change; Environment Effects

20040110628 Lawrence Livermore National Lab., Livermore, CA
Early-Time Observations of Gamma-Ray Burst Error Boxes with the Livermore Optical Transient Imaging System
Williams, G. G.; Aug. 01, 2000; 144 pp.; In English
Report No.(s): DE2004-15007544; UCRL-LR-141147; No Copyright; Avail: Department of Energy Information Bridge

Despite the enormous wealth of gamma-ray burst (GRB) data collected over the past several years the physical mechanism which causes these extremely powerful phenomena is still unknown. Simultaneous and early time optical observations of GRBs will likely make a great contribution t o our understanding. LOTIS is a robotic wide field-of-view telescope dedicated to the search for prompt and early-time optical afterglows from gamma-ray bursts. LOTIS began routine operations in October 1996 and since that time has responded to over 145 gamma-ray burst triggers. Although LOTIS has not yet detected prompt optical emission from a GRB its upper limits have provided constraints on the theoretical emission mechanisms. Super-LOTIS, also a robotic wide field-of-view telescope, can detect emission 100 times fainter than LOTIS is capable of detecting. Routine observations from Steward Observatory Kitt Peak Station will begin in the immediate future. During engineering test runs under bright skies from the grounds of Lawrence Livermore National Laboratory Super-LOTIS provided its first upper limits on the early-time optical afterglow of GRBs. This dissertation provides a summary of the results from LOTIS and Super- LOTIS through the time of writing. Plans for future studies with both systems are also presented.
NTIS
Gamma Rays; Bursts; Detection; Visual Observation; Imaging Techniques

20040110698 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Discrete X-Ray Source Populations and Star-Formation History in Nearby Galaxies
Zezas, Andreas; August 2004; 3 pp.; In English
Contract(s)/Grant(s): NAG5-13056; No Copyright; Avail: CASI; A01, Hardcopy

This program aims in understanding the connection between the discrete X-ray source populations observed in nearby galaxies and the history of star-formation in these galaxies. The ultimate goal is to use this knowledge in order to constrain X-ray binary evolution channels. For this reason although the program is primarily observational it has a significant modeling component. During the first year of this study we focused on the definition of a pilot sample of galaxies with well know star-formation histories. A small part of this sample has already been observed and we performed initial analysis of the data. However, the majority of the objects in our sample either have not been observed at all, or the detection limit of the existing observations is not low enough to probe the bulk of their young X-ray binary populations. For this reason we successfully proposed for additional Chandra observations of three targets in Cycle-5. These observations are currently being performed. The analysis of the (limited) archival data for this sample indicated that the X-ray luminosity functions (XLF) of the discrete sources in these galaxies may not have the same shape as is widely suggested. However, any solid conclusions are hampered by the small number of detected sources. For this reason during the second year of this study, we will try to extend the sample in order to include more objects in each evolutionary stage. In addition we are completing the analysis of the Chandra monitoring observations of the Antennae galaxies. The results from this work, apart from important clues on the nature of the most luminous sources (Ultra-luminous X-ray sources; ULXs) provide evidence that source spectral and/or temporal variability does not significantly affect the shape of their X-ray luminosity functions. This is particularly important for comparisons between the XLFs of different galaxies and comparisons with predictions from theoretical models. Results from this work have been presented in several conferences. Refereed journal papers presenting these conclusions are currently in preparation. An important part of this study is the Chandra survey of the Small Magellanic Cloud, our second nearest star-forming galaxy. So far we have been awarded 5 Chandra observations of the central youngest part of the galaxy. These observations will help to study the very faint end of the young X-ray binary populations which is not possible to probe in more distant objects. Results from this study have been presented in several conferences and two papers are in preparation. In addition during year-2 we are planning of undertaking the task of identifying optical counterparts to the X-ray sources, which will help us to isolate interlopers (sources not associated with the SMC) and classify the X-ray binaries which are found to be associated with the SMC. In the theoretical front, the Star-Track X-ray binary population synthesis code which will be used for the modeling of the X-ray binary populations (led by co-I V. Kalogera and C. Belczynski), is complete. A first test using the XLF of the star-forming galaxy NGC-1569 showed remarkable agreement between the observed and the modeled XLF. These results are presented in an ApJ. Letters paper (Belczynski et al, 2004, 601, 147). During year-2 of this study we are planning of performing a parameter study in order to investigate which parameters are most important for the shape of the XLF. In addition we will perform comparisons with observations of other galaxies from our sample as they become available. Derived from text

Galaxies; Populations; Star Formation; X Ray Sources

20040110720 Space Telescope Science Inst., Baltimore, MD, USA

Monitoring the Variable Absorption in the Seyfert 1 Galaxy NGC 3783 with FUSE, HST, and Chandra Observations

Kriss, Gerard A.; August 17, 2004; 3 pp.; In English

Contract(s)/Grant(s): NAG5-10379; STScI Proj. J0300; No Copyright; Avail: CASI; A01, Hardcopy

The analysis of FUSE observations funded by this grant aims to understand the nature and origin of the absorbing gas in NGC 3783. We have used the simultaneous FUSE, HST, and Chandra data to determine the radial location, density, and ionization state of the absorbing gas and measure its evolution in ionization, column density, velocity, and coverage of the active nucleus. As part of this program, Dr. Gerard Kriss supplied advice and assistance in planning and scheduling the FUSE observations of NGC 3783 coordinated with the HST/STIS observations, and co-authored the publications listed in the bibliography and summarized below.

Author (revised)

Seyfert Galaxies; Ultraviolet Astronomy; X Ray Astronomy; Ionized Gases; Interstellar Gas

20040110741 California Univ., Berkeley, CA, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Stanford Linear Accelerator Center, Stanford, CA, USA

Vanishing Two Loop Cosmological Constants in Nonsupersymmetric Strings

Kachru, S.; Silverstein, E.; Oct. 16, 1998; 20 pp.; In English

Report No.(s): DE2004-9938; LBNL-42248; No Copyright; Avail: Department of Energy Information Bridge

It has recently been suggested that in certain special nonsupersymmetric type II string compactifications, at least the first two perturbative contributions to the cosmological constant Lambda vanish. Support for perturbative vanishing beyond 1-loop (as well as evidence for the absence of some nonperturbative contributions) has come from duality arguments. There was also a direct 2-loop computation which was incomplete; in this note we explain the deficiency of the previous 2-loop calculation

and discuss the complete 2-loop computation in two different models. The corrected analysis yields a vanishing 2-loop contribution to Lamda in these models
NTIS
Supersymmetry; Strings

91
LUNAR AND PLANETARY SCIENCE AND EXPLORATION

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

20040095941 NASA Langley Research Center, Hampton, VA, USA
Satellite Remote Sensing of Cirrus: An Overview
Minnis, Patrick; [1998]; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The determination of cirrus properties over relatively large spatial and temporal scales will, in most instances, require the use of satellite data. Global coverage, at resolutions as high as several meters are attainable with Landsat, while temporal coverage at 1-min intervals is now available with the latest Geostationary Operational Environmental Satellite (GOES) imagers. Cirrus can be analyzed via interpretation of the radiation that they reflect or emit over a wide range of the electromagnetic spectrum. Many of these spectra and high-resolution satellite data can be used to understand certain aspects of cirrus clouds in particular situations. Production of a global climatology of cirrus clouds, however, requires compromises in spatial, temporal, and spectral coverage. This paper summarizes the state of the art and the potential for future passive remote sensing systems for both understanding cirrus formation and acquiring sufficient statistics to constrain and refine weather and climate models.
Author
Satellite Observation; Remote Sensing; Cirrus Clouds; Climate Models

20040105531 Arizona State Univ., Tempe, AZ, USA
[Discovery of Gullies on Mars Apparently Formed by Recent Seepage of Fluids]
Knauth, L. Paul; [2004]; 7 pp.; In English
Contract(s)/Grant(s): NAG5-9430; No Copyright; Avail: CASI; A02, Hardcopy

Most of the proposed objectives in this grant were achieved during the 3 year duration of the grant and its one year extension. In addition, shortly after initiation of the grant, the discovery of gullies on Mars apparently formed by recent seepage of fluids was announced. Together with partial support from the Astrobiology Institute, I devoted considerable effort during the grant interval into understanding the origin of these gullies because of their astrobiological significance. In addition, longstanding investigations of the environmental conditions of the Early Earth initiated years ago under previous NASA and NSF funding reached fruition and these were presented and published. This report summarizes the significant findings reported during the grant interval. Some of the work initiated during this interval has been completed under the subsequent Exobiology grant and will be reported at the appropriate time.
Derived from text
Exobiology; Mars Surface; Fluids; Planetary Geology; Seepage

20040110417 NASA Langley Research Center, Hampton, VA, USA
Asymmetry in the Diurnal Variation of Surface Albedo
Mayor, S.; Smith, W. L., Jr.; Nguyen, L.; Alberta, T. A.; Minnis, P.; Whitlock, C. H.; Schuster, G. L.; [1996]; 3 pp.; In English
Contract(s)/Grant(s): ITF-214216-A-Q1; No Copyright; Avail: CASI; A01, Hardcopy

Remote sensing of surface properties and estimation of clear-sky and surface albedo generally assumes that the albedo depends only on the solar zenith angle. The effects of dew, frost, and precipitation as well as evaporation and wind can lead to some systematic diurnal variability resulting in an asymmetric diurnal cycle of albedo. This paper examines the symmetry of both surface-observed albedos and top-of-the-atmosphere (TOA) albedos derived from satellite data. Broadband and visible surface albedos were measured at the Department of Energy Atmospheric Radiation Measurement (ARM) Program Southern Great Plains Central Facility, at some fields near the ARM site, and over a coniferous forest in eastern Virginia. Surface and wind conditions are available for most cases. GOES-8 satellite radiance data are converted to broadband albedo using bidirectional reflectance functions and an empirical narrowband-to-broadband relationship. The initial results indicate that surface moisture has a significant effect and can change the albedo in the afternoon by 20% relative to its morning counterpart.

Such effects may need to be incorporated in mesoscale and even large-scale models of atmospheric processes.
Author
Asymmetry; Remote Sensing; Albedo; Surface Properties

92
SOLAR PHYSICS

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

20040110974 NASA Marshall Space Flight Center, Huntsville, AL, USA
Application of the Maximum Amplitude-Early Rise Correlation to Cycle 23
Willson, Robert M.; Hathaway, David H.; June 2004; 24 pp.; In English
Report No.(s): NASA/TP-2004-213281; M-1113; No Copyright; Avail: CASI; A03, Hardcopy

On the basis of the maximum amplitude-early rise correlation, cycle 23 could have been predicted to be about the size of the mean cycle as early as 12 mo following cycle minimum. Indeed, estimates for the size of cycle 23 throughout its rise consistently suggested a maximum amplitude that would not differ appreciably from the mean cycle, contrary to predictions based on precursor information. Because cycle 23 s average slope during the rising portion of the solar cycle measured 2.4, computed as the difference between the conventional maximum (120.8) and minimum (8) amplitudes divided by the ascent duration in months (47), statistically speaking, it should be a cycle of shorter period. Hence, conventional sunspot minimum for cycle 24 should occur before December 2006, probably near July 2006 (+/-4 mo). However, if cycle 23 proves to be a statistical outlier, then conventional sunspot minimum for cycle 24 would be delayed until after July 2007, probably near December 2007 (+/-4 mo). In anticipation of cycle 24, a chart and table are provided for easy monitoring of the nearness and size of its maximum amplitude once onset has occurred (with respect to the mean cycle and using the updated maximum amplitude-early rise relationship).
Author
Sunspot Cycle; Solar Cycles; Estimates; Slopes

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*.

20040100694 NASA, Washington, DC, USA
Requirements for Simulating Space Radiation With Particle Accelerators
Schimmerling, W.; Wilson, J. W.; Cucinotta, F.; Kim, M-H Y.; [2004]; 28 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Interplanetary space radiation consists of fully ionized nuclei of atomic elements with high energy for which only the few lowest energy ions can be stopped in shielding materials. The health risk from exposure to these ions and their secondary radiations generated in the materials of spacecraft and planetary surface enclosures is a major limiting factor in the management of space radiation risk. Accurate risk prediction depends on a knowledge of basic radiobiological mechanisms and how they are modified in the living tissues of a whole organism. To a large extent, this knowledge is not currently available. It is best developed at ground-based laboratories, using particle accelerator beams to simulate the components of space radiation. Different particles, in different energy regions, are required to study different biological effects, including beams of argon and iron nuclei in the energy range 600 to several thousand MeV/nucleon and carbon beams in the energy range of approximately 100 MeV/nucleon to approximately 1000 MeV/nucleon. Three facilities, one each in the USA, in Germany and in Japan, currently have the partial capability to satisfy these constraints. A facility has been proposed using the Brookhaven National Laboratory Booster Synchrotron in the USA; in conjunction with other on-site accelerators, it will be able to provide the full range of heavy ion beams and energies required. International cooperation in the use of these facilities is essential to the development of a safe international space program.
Author
Simulation; Particle Accelerators; Interplanetary Medium; Extraterrestrial Radiation; Radiobiology

20040100696 NASA Langley Research Center, Hampton, VA, USA
The Local Tissue Environment During the September 29, 1989 Solar Particle Event
Kim, M.-H. Y.; Wilson, J. W.; Cucinotta, F. A.; Simonsen, L. C.; Atwell, W.; Badavi, F. F.; Miller, J.; [2004]; 5 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

The solar particle event (SPE) of September 29, 1989, produced an iron-rich spectrum with energies approaching 1 GeV/amu with an energy power index of 2.5. These high charge and energy (HZE) ions of the iron-rich SPEs challenge conventional methods of SPE shield design and assessment of astronaut risks. Shield and risk assessments are evaluated using the HZETRN code with computerized anatomical man (CAM) model for astronaut s body tissues. Since the HZE spectra decline rapidly with energy and HZE attenuation in materials is limited by their penetration power, details of the mass distributions about the sensitive tissues (shielding materials and the astronaut's body) are important determining factors of the exposure levels. Typical space suit and lightly shielded structures allow significant contributions from HZE components to some critical body tissues and have important implications on the models for risk assessment. Only a heavily shielded equipment room of a space vehicle or habitat provides sufficient shielding for the early response at sensitive organs from this event. The February 23, 1956 event of similar spectral characteristics and ten times this event may have important medical consequences without a well-shielded region.
Author
Solar Corpuscular Radiation; Tissues (Biology); Bionics; Computerized Simulation

20040100701 NASA Langley Research Center, Hampton, VA, USA
Overview of Radiation Environments and Human Exposures
Wilson, John W.; [2004]; 65 pp.; In English; No Copyright; Avail: CASI; A04, Hardcopy

Human exposures to ionizing radiation have been vastly altered by developing technology in the last century. This has been most obvious in the development of radiation generating devices and the utilization of nuclear energy. But even air travel has had its impact on human exposure. Human exposure increases with advancing aircraft technology as a result of the higher operating altitudes reducing the protective cover provided by the Earth s atmosphere from extraterrestrial radiations. This increase in operating altitudes is taken to a limit by human operations in space. Less obvious is the changing character of the radiations at higher altitudes. The associated health risks are less understood with increasing altitude due to the increasing complexity and new field components found in high altitude and space operations.
Author
Exposure; Extraterrestrial Radiation; Ionizing Radiation; Human Beings; General Overviews

20040110318 NASA Langley Research Center, Hampton, VA, USA
Materials for Shielding Astronauts from the Hazards of Space Radiations
Wilson, J. W.; Cucinotta, F. A.; Miller, J.; Shinn, J. L.; Thibeault, S. A.; Singleterry, R. C.; Simonsen, L. C.; Kim, M. H.; [1997]; 13 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

One major obstacle to human space exploration is the possible limitations imposed by the adverse effects of long-term exposure to the space environment. Even before human spaceflight began, the potentially brief exposure of astronauts to the very intense random solar energetic particle (SEP) events was of great concern. A new challenge appears in deep space exploration from exposure to the low-intensity heavy-ion flux of the galactic cosmic rays (GCR) since the missions are of long duration and the accumulated exposures can be high. Because cancer induction rates increase behind low to rather large thickness of aluminum shielding according to available biological data on mammalian exposures to GCR like ions, the shield requirements for a Mars mission are prohibitively expensive in terms of mission launch costs. Preliminary studies indicate that materials with high hydrogen content and low atomic number constituents are most efficient in protecting the astronauts. This occurs for two reasons: the hydrogen is efficient in breaking up the heavy GCR ions into smaller less damaging fragments and the light constituents produce few secondary radiations (especially few biologically damaging neutrons). An overview of the materials related issues and their impact on human space exploration will be given.
Author
Astronauts; Extraterrestrial Radiation; Galactic Cosmic Rays; Solar Radiation Shielding; Radiation Hazards

20040110719 NASA Langley Research Center, Hampton, VA, USA
Overview of HZETRN and BRNTRN Space Radiation Shielding Codes
Wilson, John W.; Cucinotta, F. A.; Shinn, J. L.; Simonsen, L. C.; Badavi, F. F.; [1997]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The NASA Radiation Health Program has supported basic research over the last decade in radiation physics to develop ionizing radiation transport codes and corresponding data bases for the protection of astronauts from galactic and solar cosmic rays on future deep space missions. The codes describe the interactions of the incident radiations with shield materials where their content is modified by the atomic and nuclear reactions through which high energy heavy ions are fragmented into less massive reaction products and reaction products are produced as radiations as direct knockout of shield constituents or produced as de-excitation products in the reactions. This defines the radiation fields to which specific devices are subjected onboard a spacecraft. Similar reactions occur in the device itself which is the initiating event for the device response. An overview of the computational procedures and data base with some applications to photonic and data processing devices will be given.
Author
Extraterrestrial Radiation; Radiation Shielding; General Overviews; Computer Programs; NASA Programs

20040110777 NASA Langley Research Center, Hampton, VA, USA
MESTRN: A Deterministic Meson-Muon Transport Code for Space Radiation
Blattnig, Steve R.; Norbury, John W.; Norman, Ryan B.; Wilson, John W.; Singleterry, Robert C., Jr.; Tripathi, Ram K.; August 2004; 159 pp.; In English
Contract(s)/Grant(s): NCC1-260; NGT1-52217; NCC1-354; WU 23-349-06-01
Report No.(s): NASA/TM-2004-212995; L-19001; No Copyright; Avail: CASI; A08, Hardcopy
A safe and efficient exploration of space requires an understanding of space radiations, so that human life and sensitive equipment can be protected. On the way to these sensitive sites, the radiation fields are modified in both quality and quantity. Many of these modifications are thought to be due to the production of pions and muons in the interactions between the radiation and intervening matter. A method used to predict the effects of the presence of these particles on the transport of radiation through materials is developed. This method was then used to develop software, which was used to calculate the fluxes of pions and muons after the transport of a cosmic ray spectrum through aluminum and water. Software descriptions are given in the appendices.
Author
Extraterrestrial Radiation; Mesons; Muons; Radiation Transport; Parameterization; Computer Programs

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