NASA SP-7037 (328)
March 1996

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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This issue of *Aeronautical Engineering, A Continuing Bibliography with Indexes* (NASA SP-7037) lists 98 reports, articles, and other documents recently announced in the NASA STI Database.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.

Two indexes—subject and author are included.

The NASA CASI price code table, addresses of organizations, and document availability information are located at the back of this issue.

Table of Contents

Records are arranged in categories 1 through 19, the first nine coming from the Aeronautics division of *STAR*, followed by the remaining division titles. Selecting a category will link you to the collection of records cited in this issue pertaining to that category.

Indexes

Two indexes are available. You may use the **Find** command under the **Tools** menu while viewing the PDF file for direct match searching on any text string. You may also view the indexes provided, for searching on *NASA Thesaurus* subject terms and author names.

Selecting an index above will link you to that comprehensive listing.

Appendix

Select **Appendix** for important information about NASA Scientific and Technical Information (STI) Office products and services, including registration with the NASA Center for AeroSpace Information (CASI) for access to the NASA CASI TRS (Technical Report Server), and availability and pricing information for cited documents.

Typical Report Citation and Abstract

ON MICROFICHE

↓

ACCESSION NUMBER → **N96-10751#** Sandia National Labs., Albuquerque, NM. ← **CORPORATE SOURCE**

TITLE → **Minimizing phylogenetic number to find good evolutionary trees**

AUTHORS → Goldberg, Leslie Ann; Goldberg, Paul W.; Phillips, Cynthia A.; Sweedyk, Elizabeth (California Univ., Berkeley, CA.); and Warnow, Tandy (Pennsylvania Univ., Philadelphia, PA.) ← **AUTHORS' AFFILIATION**

PUBLICATION DATE → 1995 26 p Presented at the 1995 Symposium on Combinatorial Pattern Matching, Helsinki, Finland, 4-7 Jul. 1995 Sponsored by California Legislative Grant

CONTRACTS/GRANTS → Contract(s)/Grant(s): (DE-AC04-94AL-85000; NSF CCR-94-57800)

REPORT NO.(S) → Report No.(s): (DE95-011893; SAND-95-0831C; CONF-9507123-1) Avail: CASI HC A03/MF A01 ← **AVAILABILITY AND PRICE CODE**

ABSTRACT → Inferring phylogenetic trees is a fundamental problem in computational-biology. We present a new objective criterion, the phylogenetic number, for evaluating evolutionary trees for species defined by biomolecular sequences or other qualitative characters. The phylogenetic number of a tree T is the maximum number of times that any given character state arises in T. By contrast, the classical parsimony criterion measures the total number of times that different character states arise in T. We consider the following related problems: finding the tree with minimum phylogenetic number, and computing the phylogenetic number of a given topology in which only the leaves are labeled by species. When the number of states is bounded (as is the case for biomolecular sequence characters), we can solve the second problem in polynomial time. We can also compute a fixed-topology 2-phylogeny (when one exists) for an arbitrary number of states. This algorithm can be used to further distinguish trees that are equal under parsimony. We also consider a number of other related problems. DOE

SUBJECT TERMS → *Algorithms; Biological Evolution; Chemical Evolution; Genetics; Molecular Biology*

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 328)

MARCH 1996

01 AERONAUTICS (GENERAL)

N96-14786*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A k-omega turbulence model for quasi-three-dimensional turbomachinery flows

Chima, Rodrick V.; Sep. 1995 14 p Presented at the 34th Aerospace Sciences Meeting, Reno, NV, 15-18 Jan. 1996; sponsored by AIAA

Contract(s)/Grant(s): (RTOP 505-62-10)

Report No.(s): (NASA-TM-107051; E-9897; NAS 1. 15: 107051) Avail: CASI HC A03/MF A01

A two-equation k-omega turbulence model has been developed and applied to a quasi-three-dimensional viscous analysis code for blade-to-blade flows in turbomachinery. the code includes the effects of rotation, radius change, and variable stream sheet thickness. The flow equations are given and the explicit runge-Kutta solution scheme is described. the k-omega model equations are also given and the upwind implicit approximate-factorization solution scheme is described. Three cases were calculated: transitional flow over a flat plate, a transonic compressor rotor, and transonic turbine vane with heat transfer. Results were compared to theory, experimental data, and to results using the Baldwin-Lomax turbulence model. The two models compared reasonably well with the data and surprisingly well with each other. Although the k-omega model behaves well numerically and simulates effects of transition, freestream turbulence, and wall roughness, it was not decisively better than the Baldwin-Lomax model for the cases considered here.

Author

Compressor Rotors; Computational Fluid Dynamics; Flat Plates; Rotor Blades (turbomachinery); Three Dimensional Flow; Transition Flow; Transonic Compressors; Turbulence Effects; Turbulence Models; Turbulent Flow;

N96-14883*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

Cognitive models of pilot categorization and prioritization of flight-deck information

Jonsson, Jon E.; (McDonnell-Douglas Aerospace, Long Beach, CA.)and Ricks, Wendell R.; Aug. 1995 34 p Sponsored by NASA, Washington

Contract(s)/Grant(s): (RTOP 505-64-13-22)

Report No.(s): (NASA-TP-3528; L-17463; NAS 1.60:3528) Avail: CASI HC A03/MF A01

In the past decade, automated systems on modern commercial flight decks have increased dramatically. Pilots now regularly interact and share tasks with these systems. This interaction has led human factors research to direct more attention to the pilot's cognitive processing and mental model of the information flow occurring on the flight deck. The experiment reported herein investigated how pilots mentally represent and process information typically available during flight. Fifty-two commercial pilots participated in tasks that required them to provide similarity ratings for pairs of flight-deck information and to prioritize this information under two contextual conditions. Pilots processed the information along three cognitive dimensions. These dimensions included the flight function and the flight action that the information supported and how frequently pilots refer to the information. Pilots classified the information as aviation, navigation, communications, or systems administration information. Prioritization results indicated a high degree of consensus among pilots, while scaling results revealed two dimensions along which information is prioritized. Pilot cognitive workload for flight-deck tasks and the potential for using these findings to operationalize cognitive metrics are evaluated. Such measures may be useful additions for flight-deck human performance evaluation.

Author

Aircraft Pilots; Aviation Psychology; Cognition; Cybernetics; Human Factors Engineering; Man Machine Systems; Mental Performance; Pilot Performance;

N96-14963# Sandia National Labs., Albuquerque, NM.

Performance analysis of bonded composite doublers on aircraft structures

Roach, D.; 1995 25 p Presented at the 10th International Conference on Composite Materials, Vancouver, Canada, 14-18 Aug. 1995

Contract(s)/Grant(s): (DE-AC04-94AL-85000)

Report No.(s): (DE95-016737; SAND-95-1886C; CONF-950833-4) Avail: CASI HC A03/MF A01

Researchers contend that composite repairs (or structural reinforcement doublers) offer numerous advantages over metallic patches including corrosion resistance, light weight, high strength, elimination of rivets, and time savings in installation. Their use in commercial aviation has been stifled by uncertainties surrounding their application, subsequent inspection and long-term endurance. The process of repairing or reinforcing airplane structures is time consuming and the design is dependent upon an accompanying stress and fatigue analysis. A repair that is too stiff may result in a loss of fatigue life, continued growth of the crack being repaired, and the initiation of a new flaw in the undesirable high stress field around the patch. Uncertainties in load spectrums used to design repairs exacerbates these problems as does the use of rivets to apply conventional doublers. Many of these repair or structural reinforcement difficulties can be addressed through the use of composite doublers. Primary among unknown entities are the effects of non-optimum installations and the certification of adequate inspection procedures. This paper presents on overview of a program intended to introduce composite doubler technology to the US commercial aircraft fleet. In this project, a specific composite application has been chosen on an L-1011 aircraft in order to focus the tasks on application and operation issues. Through the use of laboratory test structures and flight demonstrations on an in-service L-1011 airplane, this study is investigating composite doubler design, fabrication, installation, structural integrity, and non-destructive evaluation. In addition to providing an overview of the L-1011 project, this paper focuses on a series of fatigue and strength tests which have been conducted in order to study the damage tolerance of composite doublers. Test results to-date are presented.
DOE
Aircraft Structures; Boron; Composite Materials; Composite Structures; Crack Propagation; Epoxy Compounds; L-1011 Aircraft; Nondestructive Tests; Residual Strength; Static Tests;

N96-15157* National Aeronautics and Space Administration, Washington, DC.
Aeronautical engineering: A continuing bibliography with indexes (supplement 324)
Dec. 1995 170 p
Report No.(s): (NASA-SP-7037(324); NAS 1.21: 7037(324)
Avail: CASI HC A08

This bibliography lists 149 reports, articles, and other documents introduced into the NASA scientific and technical information system in December 1995. Subject coverage includes engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.
Derived from text
Aerodynamics; Aeronautical Engineering; Bibliographies; Indexes (documentation);

N96-15206# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
Aerodynamics of 3-D aircraft afterbodies [lAerodynamique des arriere-corps tridimensionnels]
1 Sep. 1995 479 p
Report No.(s): (AGARD-AR-318; ISBN-92-836-1023-7; NIPS-95-06219) Avail: CASI HC A21/MF A04

This report presents the findings of a study performed by AGARD Working Group 17 into the current understanding of the aerodynamics of complex 3-D aircraft afterbodies and the status of the methods now available to aid in their design optimization. The major part of the report is given over to the results obtained and lessons learned from the application of current CFD procedures to a selection of test cases ranging in complexity from a simple axisymmetric body with jet to a twin jet body complete with wings and empennage. Comprehensive descriptions of the selected test cases with their experimental data bases are appended to the report in the hope that these will continue to serve other researchers in the field. Other sections of the report review the developments made in empirical/semi-empirical procedures and in the experimental techniques applicable to support both future computational developments and aid directly in the task of aircraft design optimization.
Derived from text
Aerodynamic Characteristics; Afterbodies; Aircraft Design; Design Analysis; Optimization; Three Dimensional Bodies; Three Dimensional Flow;

N96-15267* National Aeronautics and Space Administration, Washington, DC.
Aeronautical engineering: A continuing bibliography with indexes (supplement 323)
Nov. 1995 182 p
Report No.(s): (NASA-SP-7037(323); NAS 1.21:7037 (323)
Avail: CASI HC A09

This bibliography lists 518 reports, articles, and other documents introduced into the NASA scientific and technical information system in November 1995. Subject coverage includes: design, construction and testing of aircraft and aircraft engines; aircraft components, equipment, and systems; ground support systems; and theoretical and applied aspects of aerodynamics and general fluid dynamics.
Author
Aerodynamics; Aeronautical Engineering; Bibliographies; Indexes (documentation);

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

N96-14190* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
Rotorcraft blade-vortex interaction controller Patent
Schmitz, Frederic H.; inventor. 1 Aug. 1995 24 p Filed6 Nov. 1992
Report No.(s): (NASA-CASE-ARC-11992-1; US-PATENT-CLASS-244-17.11; US-PATENT-CLASS-244/1-N; US-PATENT-CLASS-244/199; INT-PATENT-CLASS- B64C-27/00; US-PATENT-5,437,419; US-PATENT-APPL-SN- 97 Report No.(s): 12790; NIPS-95-06017) Avail: US Patent and Trademark Office

Blade-vortex interaction noises, sometimes referred to as 'blade slap', are avoided by increasing the absolute value of inflow to the rotor system of a rotorcraft. This is accomplished by creating a drag force which causes the angle of the tip-path plane of the rotor system to become more negative or more positive.
Author
Blade Slap Noise; Blade-vortex Interaction; Controllers; Propeller Noise;

N96-14219 Institut Franco-Allemand de Recherches, Saint-Louis (France).
Identification of an absolutely-convectively unstable region in a compressible wake [Absolut-konvektiv instabilen bereichsverteilung in einem kompressiblen nachlauf]
Leopold, F.; and Brevdo, L.; 1995 11 p In GEORGIAN
Report No.(s): (PB95-254561; ISL-PU-329/94) Avail: Issuing Activity (National Technical Information Service (NTIS))

A laminar flow is absolutely unstable when small perturbations grow without limit at the point of their origin. Convective instability, but absolute stability, occurs when over time perturbations move from their point of origin without perturbing the primary flow. The method for recognizing convective and absolute instabilities was used for the investigation of the initial conditions profile (velocity, temperature and pressure) in an axially symmetric compressible wake behind a circular cylinder oriented lengthwise to the flow. Under the assumption of locally parallel initial conditions the authors show by numerical calculations that for axially symmetric perturbations, as well as for the first asymmetrical perturbation mode, a region of absolute instability occurs directly behind the cylinder. This demonstrates the conjecture that not only does such a demarcation exist for the incompressible case, but it is a characteristic of every oscillating wake. Within the context of the method of absolute and convective instabilities, the authors solved a linear initial value-boundary stability problem under the assumptions of parallel flow using a Fourier-Laplace transformation.
NTIS
Compressible Flow; Flow Stability; Laminar Flow; Turbulent Flow; Wakes;

N96-14552# Naval Postgraduate School, Monterey, CA.
An investigation of the transonic viscous drag coefficient for axi-symmetric bodies M.S. Thesis
Fan, Yue Sang; Mar. 1995 64 p
Report No.(s): (AD-A297698) Avail: CASI HC A04/MF A01

Viscous drag in the transonic regime over an axisymmetric body with a unique aft contour surface is investigated. The forebody is composed of an arbitrary ellipsoid. The unique aft contour surface has been obtained by an exact solution of the small perturbation transonic equation, using guidelines and tools developed at the Naval Postgraduate School. This unique contour allows the delay of shock formation in the aft portion, hence delaying the onset of wave drag which results in a reduction of the overall transonic pressure drag on the body. The drag coefficient thus computed is compared with another axisymmetric body with the same ellipsoid forebody but a simple boat-tailed conical afterbody. Computational fluid dynamics (CFD) has been used to compute the viscous flow over the two bodies at zero incidence using a Navier-Stokes flow-solver. Results obtained confirm the advantage of the special shaped afterbody over the conical afterbody by showing the delayed formation of shock waves at the aft portion in transonic flow, consequently achieving a lower maximum drag coefficient of approximately 5.5%. These results can be used in the design of low pressure-drag surfaces for shapes such as missiles, projectiles, aircraft external ferry tanks, and aircraft engine nacelles for improved performance within the transonic flight regime.
DTIC
Aerodynamic Drag; Afterbodies; Axisymmetric Bodies; Drag Reduction; Transonic Flow; Viscous Drag; Viscous Flow; Wave Drag;

N96-14798# United Technologies Research Center, East Hartford, CT.
Numerical unsteady aerodynamic simulator for blade forced response phenomena Final Report, 1 Jun. 1992 - 1 Dec. 1994
Ayer, T. C.; and Verdon, J. M.; Dec. 1994 72 p
Contract(s)/Grant(s): (F33615-92-C-2212)
Report No.(s): (AD-A298470; R94-970312-4; WL-TR-95-2011) Avail: CASI HC A04/MF A01

This report describes the application of a modern, time-accurate, Euler/Navier-Stokes analysis to the prediction of unsteady subsonic and transonic flows through a two-dimensional cascade. In particular, unsteady flows excited by har-

monic, pure torsional and pure bending vibrations of the blades of the Tenth Standard Cascade are considered. The purpose is to validate the Euler/Navier-Stokes analysis along with an existing linearized inviscid analysis for unsteady flows that are representative of those associated with blade flutter in modern fans and compressors. The analysis is also applied to determine the relative importance of nonlinear and viscous effects in the unsteady response of a cascade to prescribed blade motions. The results of the study indicate a close agreement between inviscid and viscous blade loadings for unsteady subsonic flows. For unsteady transonic flows, shocks and their motions introduce significant nonlinear or second and higher harmonic contributions to the local unsteady response.
DTIC
Cascade Flow; Computational Fluid Dynamics; Flutter; Inviscid Flow; Rotor Aerodynamics; Subsonic Flow; Transonic Flow; Turbomachine Blades; Unsteady Aerodynamics; Unsteady Flow; Viscous Flow;

N96-14809# Polytechnic Univ., Brooklyn, NY. Dept. of Aerospace Engineering.
Experimental investigation of three-dimensional vortex-airfoil interaction in a supersonic stream Final Report, 21 Mar. 1994 - 30 Jun. 1995
Jul. 1995 82 p
Contract(s)/Grant(s): (F49620-94-1-0210)
Report No.(s): (AD-A298038; AFOSR-95-0504TR) Avail: CASI HC A05/MF A01

An experimental study of the interaction between stream-wise vortices and a two-dimensional surface was conducted in a Mach 2.5 flow. The influence of oblique shock wave intensity on the inherently three-dimensional interaction was examined for vortices of variable strength. Planar laser sheet visualizations of the flowfield generated by the interaction at several distances downstream of the wedge leading edge were performed in order to gain an understanding of vortex behavior at distances further downstream. Results indicated that the interaction of a moderate strength vortex with an oblique shock wave leads to the formation of a steady separated shock structure upstream of the oblique shock front. Planar laser sheet visualization of the flowfield revealed an expansion of the vortex core in crossing a strong oblique shock front. The vortical structure was observed to persist along the entire chord of the shock generating wedge but was seen to diffuse with distances downstream of the wedge leading edge. Measurements of the vortex center above the wedge surface indicated that immediately downstream of the normal portion of the bulged-forward shock wave the vortex center was parallel to the direction of the free stream flow.
DTIC
Angle of Attack; Flow Distribution; Flow Visualization; Interactional Aerodynamics; Leading Edges; Oblique Shock Waves; Pressure Distribution; Shock Wave Interaction; Supersonic Flow; Vortices; Wind Tunnel Tests; Wing Tips;

N96-14811# Stanford Univ., CA. Dept. of Mechanical Engineering.
Large eddy simulation of turbulent flow over an airfoil Final Technical Report, 30 Sep. 1993 - 29 Mar. 1995
Moin, Parviz; May 1995 17 p
Contract(s)/Grant(s): (F49620-93-1-0629)
Report No.(s): (AD-A298050; AFOSR-95-0511TR) Avail: CASI HC A03/MF A01

The turbulent flow over a NACA 4412 airfoil at angle of incidence corresponding to maximum lift (12 degrees) has been computed via large-eddy simulation. Two different numerical approaches, one based on a conventional structured mesh and one with a more economical unstructured mesh, have been employed. Results from both simulations differ considerably from each other and from the available experimental data. Differences are found with respect to occurrence of transition near the suction peak and with respect to the amount of backflow (incipient separation) near the trailing edge. The unstructured mesh code predicts rapid boundary layer growth and separation near the trailing edge, whereas the flow remains attached in the structured mesh simulation. It was concluded that a better matching of the transition mechanism (boundary layer tripping) which was employed in the experiments is paramount for an accurate simulation of this flow and for convergence of solutions from the two codes.
DTIC
Boundary Layer Separation; Computational Fluid Dynamics; Dynamic Models; Finite Difference Theory; Finite Element Method; Flow Distribution; Flow Visualization; Grid Generation (mathematics); Pressure Distribution; Structured Grids (mathematics); Time Series Analysis; Trailing Edges; Turbulent Flow; Unstructured Grids (mathematics);

N96-15004# Arnold Engineering Development Center, Arnold AFS, TN.
Application of a modified dynamic compression system model to a Low-Aspect-Ratio fan: Effects of inlet distortion Final Report, Oct. 1993 - Apr. 1995
Shahrokhi, Kimball A.; Aug. 1995 84 p
Report No.(s): (AD-A298525; AEDC-TR-95-16) Avail: CASI HC A05/MF A01

The objective of this research was to modify and calibrate a l-D dynamic compression system model, DYNTECC, to more accurately simulate compressor operation with steady, nonuniform inlet flow. The modifications were based upon parallel compressor theory, and modeled both circumferential and radial effects of distorted inlet flow. The modifications included circumferential and radial mass redistribution, dynamic blade response, and radial work redis-

tribution. The circumferential mass redistribution allowed mass transport between adjacent circumferential segments within the compressor section, based on an orifice flow analogy. The radial mass redistribution allowed mass transport between adjacent radial segments, based on the radial momentum equation. The dynamic blade response modeled the compressor rotor blade's response to inlet circumferential pressure distortions. A dynamic lag ratio was used to damp the model's response to a flow disturbance. The simulation uses quasi-steady stage characteristics, and the lag ratio compensated for the finite response time of the rotor blade. The work redistribution utilized scale factors, allowing the stage characteristics to be defined as a function of radius. The model was calibrated to experimental data for clean and distorted inlet conditions for a two-stage, low-aspect-ratio fan. The distorted conditions were comprised of radial and circumferential total pressure distortion.
DTIC
Compressors; Dynamic Models; Dynamic Response; Engine Inlets; Inlet Flow; Nonuniform Flow;

N96-15088# Army Cold Regions Research and Engineering Lab., Hanover, NH.
A physically based model of the form drag associated with sastrugi
Andreas, Edgar L.; Jul. 1995 18 p
Contract(s)/Grant(s): (DA PROJ. 4A1-61102-AT-24)
Report No.(s): (AD-A298688; CRREL-95-16) Avail: CASI HC A03/MF A01

On Ice Station Weddell, some characteristics of the neutral-stability-air-icedrag coefficient at a reference height of 10 m (C(sub DNl0)) were observed that had not been documented before. The main finding was that wind driven snow continually alters the sea ice surface; the resulting snowdrifts determine how large C(sub DNl0) is. In particular, this report describes three observations and attempts to explain them: (1) C(sub DNl0) is near 0.0015 when the wind is well aligned with the drifted snow; (2) C(sub DN10) is near 0.0025 when the wind makes a large angle with the dominant orientation of the snowdrifts; (3) C(sub DNl0) can increase by 20 percent if, after being well aligned with the drift patterns, the mean wind direction shifts by as little as 20 deg. To investigate this behavior of C(sub DN10), this report adapts a model developed by Raupach that partitions the total surface stress into contributions from form drag and skin friction. With reasonable choices for free model parameters and with little fine-tuning, this physically based model can reproduce the three main observations. In other words, the model seems to include the basic physics of air-ice momentum exchange. This modeling implies that 10- cm-high sastrugi-like roughness elements, rather than pressure ridges, sustain most of the form drag over compact sea ice in the western Weddell Sea. Lastly, the report speculates on what the observations and this model say about how to parameterize C(sub DN10) over snow-covered sea ice.
DTIC
Air Sea Ice Interactions; Antarctic Regions; Atlantic Ocean; Drag; Ocean Surface; Sea Ice; Skin Friction; Snow Cover; Surface Roughness; Wind Effects;

N96-15739# National Aerospace Lab., Bangalore (India). Computer Support and Services.
Multigrid technique applied for the full potential equation over an airfoil
Srinivasa, C.; 1 Feb. 1995 17 p
Report No.(s): (NAL-PD-CSS-9501; NIPS-95-06419) Avail: CASI HC A03/MF A01

The Multigrid Technique is employed to get the fast convergence of solutions for the algorithms particular to flow applications. In this paper, the technique is used for solving a full potential equation over a symmetrical airfoil. The equation is of a non-conservative form in a cartesian grid system. This paper describes the solution obtained up to three levels and for different angles of incidence. CPU times obtained for all the cases have been tabulated and show reasonable reduction for numbers of levels when compared to non-multigrid single grid level solutions. The reduction of equivalent number of iterations is also presented. The solution did not converge for higher angles of incidence nor for more number of levels. The computed pressure distributions for all the converged cases are shown. Solutions obtained for sub-critical Mach Number, critical Mach Number, and super critical Mach Number are reported on. Mesh of higher grid size is considered and the effect of the grid size on the Multigrid Technique solutions are discussed. The pressure distributions obtained have been compared with published results and found to be agreeable.
Author (revised)
Airfoils; Algorithms; Computational Fluid Dynamics; Critical Velocity; Grid Generation (mathematics); Mach Number; Multigrid Methods; Potential Flow; Potential Theory;

N96-15857*# Toledo Univ., OH.
Design geometry and design/off-design performance computer codes for compressors and turbines Final Report
Glassman, Arthur J.; Cleveland, OH, United States NASA. Lewis Research Center 1 Dec. 1995 16 p
Contract(s)/Grant(s): (NAG3-1165; RTOP 505-69-50)
Report No.(s): (NASA-CR-198433; NAS 1.26:198433; E-10041; NIPS-95-06493) Avail: CASI HC A03/MF A01

This report summarizes some NASA Lewis (i.e., government owned) computer codes capable of being used for airbreathing propulsion system studies to determine the design geometry and to predict the design/off-design performance of compressors and turbines. These are not CFD

codes; velocity-diagram energy and continuity computations are performed fore and aft of the blade rows using meanline, spanline, or streamline analyses. Losses are provided by empirical methods. Both axial-flow and radial-flow configurations are included.
Author
Applications Programs (computers); Computational Geometry; Computer Aided Design; Engine Design; Gas Turbine Engines; Performance Prediction; Propulsion System Configurations; Propulsion System Performance; Turbocompressors;

N96-16043*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.
Ground-based sensors for the SR-71 sonic boom propagation experiment
Norris, Stephen R.; Haering, Jr., Edward A.; and Murray, James E.; Sep. 1995 24 p Presented at the NASA High Speed Research Program Sonic Boom Workshop, Hampton, VA, 11-13 Sep. 1995
Contract(s)/Grant(s): (RTOP 537-03-21)
Report No.(s): (NASA-TM-104310; H-2062; NAS 1. 15: 104310) Avail: CASI HC A03/MF A01

This paper describes ground-level measurements of sonic boom signatures made as part of the SR-71 sonic boom propagation experiment recently completed at NASA Dryden Flight Research Center, Edwards, California. Ground level measurements were the final stage of this experiment which also included airborne measurements at near and intermediate distances from an SR-71 research aircraft. Three types of sensors were deployed to three station locations near the aircraft ground track. Pressure data were collected for flight conditions from Mach 1.25 to Mach 1.60 at altitudes from 30,000 to 48,000 ft. Ground-level measurement techniques, comparisons of data sets from different ground sensors, and sensor system strengths and weaknesses are discussed. The well-known N-wave structure dominated the sonic boom signatures generated by the SR-71 aircraft at most of these conditions. Variations in boom shape caused by atmospheric turbulence, focusing effects, or both were observed for several flights. Peak pressure and boom event duration showed some dependence on aircraft gross weight. The sonic boom signatures collected in this experiment are being compiled in a data base for distribution in support of the High Speed Research Program.
Author
Flight Tests; Ground Stations; Pressure Measurement; Pressure Sensors; Sonic Booms; Sr-71 Aircraft;

N96-16056# Physical Sciences, Inc., Andover, MA.
The influence of nucleation and droplet growth on the onset of condensation in supersonic nozzle expansions
Wilemski, Gerald; Wyslouzil, Barbara E.; Beals, Mitzi G.; and Frish, Michael F.; 1994 21 p Presented at the 68th Colloid and Surface Science Symposium, Stanford, CA, 22 Jun. 1994
Contract(s)/Grant(s): (DE-FG02-92ER-14257; DE-AC02-84ER-13154)
Report No.(s): (DE95-014920; CONF-9406347-1) Avail: CASI HC A03/MF A01

Unlike most other techniques used to study nucleation, supersonic nozzles do not yield nucleation rates directly because the length of time over which nucleation contributes significantly to particle formation is not easy to determine or control. Nevertheless, experiments in nozzles are extremely important because they provide higher rates of cooling, higher super-saturations and higher nucleation rates than any of the other techniques. Their operating conditions are more typical of important industrial conditions found in aerodynamic and turbo-mechanical flows where homogeneous condensation can have serious consequences for the gas flow behavior. Because the fluid mechanics of nozzles is well-understand, condensation experiments in the nozzle are amenable to sophisticated modeling efforts, and much useful insight can be gained regarding the nucleation and droplet growth processes under these severe cooling conditions. This paper summarizes recent experimental work using a gently diverging supersonic Laval nozzle to investigate the variation of onset temperature and pressure for varying amounts of condensible vapor in an excess of carrier gas. Many similar studies have been carried out previously, but the results of these studies are usually not sufficiently well documented to enable us to do modeling studies that permit assessment of the condensate characteristics at onset. By carrying out modeling of the particle size distributions for our own experiments, we can avoid this difficulty. In modeling our experimental results, we have found that the mechanism for producing observable condensate varies considerably with conditions. Nucleation of small droplets can dominate at one extreme, but droplet growth can also be found to play a dominant role at other conditions.
DOE
Condensation; Drop Size; Drops (liquids); Nucleation; Supersonic Flow; Supersonic Nozzles;

N96-16146*# Old Dominion Univ., Norfolk, VA. School of Mechanical and Aerospace Engineering.
Shape optimization of single- and two-element airfoils on multiblock grids
Lacasse, James M.; and Baysal, Oktay; 1 Jan.1995 1 p
Contract(s)/Grant(s): (NAG1-1499)
Report No.(s): (NASA-CR-199785; NAS 1.26:199785; AIAA PAPER 94-4273; NIPS-95-06444) Avail: CASI HC A01/MF A01; Abstract Only

A multiblock, discrete sensitivity analysis method is used to couple a direct optimization method and a flow analysis method. The domain is divided into smaller subdomains for which the sensitivities are obtained separately. Then, an

effective sensitivity equation is solved to complete the coupling of all the sensitivity information. The flow analysis is based on the thin-layer Navier-Stokes equations solved by an implicit, upwind-biased, finite-volume method. The method of feasible directions is used for the present gradient-based optimization approach. First, a transonic airfoil is optimized to investigate the behavior of the method in highly nonlinear flows as well as the effect of different blocking strategies on the procedure. A supercritical airfoil is produced from an initially symmetric airfoil with multiblocking affecting the path but not the final shape. Secondly, a two-element airfoil is shape optimized in subsonic flow to demonstrate the present method's capability of shaping aerodynamically interfering elements simultaneously. For a very low and a very high Reynolds number cases, the shape of the main airfoil and the flap are optimized to yield improved lift-to-drag ratios.
Author
Computational Fluid Dynamics; Finite Volume Method; Multigrid Methods; Navier-stokes Equation; Optimization; Sensitivity; Shapes; Supercritical Airfoils; Upwind Schemes (mathematics);

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

N96-14146# Naval Postgraduate School, Monterey, CA.
Aviation security human factors test and evaluation master plan for the airport demonstration Final Report
Fobes, J. L.; McAnulty, D. M.; and Klock, Brenda A.; 20 Jun. 1995 41 p
Contract(s)/Grant(s): (DTFA03-93-C-0042)
Report No.(s): (AD-A297412; A-2001009-94-U-10078; DOT/FAA/CT-95/30) Avail: CASI HC A03/MF A01

This planning document describes 36 RDT&E activities designed to assess the operational effectiveness of a suite of prototype systems for enhancing screener proficiency on conventional and computed axial tomography X-ray inspection systems. Prototype equipment under test include screener selection test batteries, interface improvements, a connection device, trainers, and performance testing systems. Host platforms, including the InVision CTX 5000, the EG&G Astrophysics TnT, and the Safe Passage International Limited's Vocation Station Safe Passage System 40, will be used to improve the inspection of carry-on and checked baggage at selected airports during operational demonstrations.
DTIC
Airports; Baggage; Human Factors Engineering; Performance Tests; Security; Tomography; X Ray Inspection;

N96-14467# Crew System Ergonomics Information Analysis Center, Wright-Patterson AFB, OH.
Flightdeck automation issues: An aviation safety reporting system analysis Technical Note, Aug. 1993 - Mar. 1994
Rehmann, Albert; Neumeier, Mark; Mitman, Robert; and Reynolds, Michael; Jun. 1995 168 p
Contract(s)/Grant(s): (DLA900-88-D-0393)
Report No.(s): (AD-A297123; DOT/FAA/CT-TN95/11) Avail: CASI HC A08/MF A02

This document describes an analysis of the Aviation Safety Reporting System (ASRS) with regards to human factors aspects concerning the implementation of data link into the flightdeck.The ASRS database contains thousands of reports concerning actual or potential deficiencies which may compromise the safety of aviation operations in the National Airspace System (NAS). The purpose of this study was twofold: first, to provide the Federal Aviation Administration (FAA) an account of the problems associated with today's highly automated aircraft; and secondly, to report the likelihood that these problems may be exacerbated and/or lessened due to the implementation of data link into the flightdeck. Detailed analysis of the ASRS reports yielded four major automation problems, specifically those attributed to the following: (1) automation failure, (2) programming errors, (3) distraction due to programming, and (4) mismanagement and confusion of automation systems. Conclusions are drawn from examining each problem area in order to assess both positive and negative aspects pertinent to the addition of data link on the flightdeck.
DTIC
Aircraft Safety; Automatic Control; Data Links; Flight Safety; Human Factors Engineering; Management Information Systems; Systems Analysis;

N96-15125# Battelle Columbus Labs., Mountain View, CA. Aviation Safety Reporting System.
Airport ramp safety and crew performance issues
Chamberlin, Roy; Drew, Charles; Patten, Marcia; and Matchette, Robert; 1 Jan. 1995 7 p Presented at the Eighth International Symposium on Aviation Psychology, OH, United States
Report No.(s): (NIPS-95-06377) Avail: CASI HC A02/MF A01

This study examined 182 ramp operations incident reports from the Aviation Safety Reporting System (ASRS) database, to determine which factors influence ramp operation incidents. It was found that incidents occurred more often during aircraft arrival operations than during departure operations; incidents occurred most often at the gate stop area, less so at the gate entry/exit areas, and least on the ramp fringe areas; and reporters cited fewer incidents when more ground crew were present. The authors offer suggestions for

both airline management and flight crews to reduce the rate of ramp incidents.
Author
Accident Prevention; Airline Operations; Flight Operations; Flight Safety; Human Performance; Operational Hazards; Safety Factors; Safety Management;

N96-15308# Lawrence Livermore National Lab., Livermore, CA.
Aircraft accident data development for aircraft risk evaluation to ground facilities through the use of G.I.S
Kimura, C. Y.; Bennett, C. T.; Sandquist, G. M.; and Smith, S.; 10 Mar. 1995 23 p Presented at the Joint ASME/JSME Pressure Vessels and Piping Conference, Honolulu, HI, 23-27 Jul. 1995
Contract(s)/Grant(s): (W-7405-ENG-48)
Report No.(s): (DE95-015901; UCRL-JC-118793; CONF-950740-75) Avail: CASI HC A03/MF A01

The close proximity of airports and air navigation facilities to certain ground facilities have been perceived to be a serious hazard to the public because of the activities or the large number of people associated with that facility. Examples of aviation threats to ground facilities are the collocation of several large commercial shopping malls near the approach and departure routes of nearby airports. Although the possibility of an aircraft crashing and hitting a particular building or facility may be quite small, the results are perceived to be serious enough to warrant additional attention. A previous paper described how the risk due to aviation traffic near ground facilities has been determined in the past, and how this risk determination could be improved by focusing on the actual traffic patterns near the facility under scrutiny. This paper will extend the concepts presented in the previous paper by the application of these concepts to a limited example situation. The airport chosen for this example application is the Salt Lake City International Airport-located near Salt Lake City, Utah. This situation will be analyzed through the use of a category of computer software called a Geographical Information System or G.I.S. Among the features of a G.I.S. that lends itself to the evaluation of risks is its ability to manage large amounts of information through the use of its database manager. Because aircraft crashes, even those involving general aviation, are relatively uncommon events, a probabilistic risk analysis must be accomplished in order to develop realistic risk estimates without undue conservatism included. This paper will describe the data required to calculate the aircraft risk to ground facilities, where that data can be obtained, and how it can be organized and modified for use by a G.I.S.
DOE
Air Traffic; Aircraft Accidents; Computer Programs; Data Base Management Systems; Geographic Information Systems; Risk; Safety Management;

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

N96-14542# Battelle Memorial Inst., Columbus, OH.
Electronic depiction of Instrument Approach Procedure (IAP) charts. Phase 1: Development and preliminary evaluation Final Report, Sep. 1993 - Sep. 1994
Hannon, Daniel J.; and Huntley, Jr., M. Stephen; May 1995 62 p
Report No.(s): (AD-A297103; DOT/FAA/RD-95/3; DOT–VNTSC-FAA-95-14) Avail: CASI HC A04/MF A01

This report describes the research program being conducted at the Volpe National Transportation Systems Center on the development of electronic aeronautical charts. The design of electronic aeronautical navigation charts raises many interrelated human factors issues including those pertaining to the physical aspects of the display screens (e.g., location in the cockpit, screen resolution, color capability, brightness range) and those affecting the piLot interaction with the software (i.e., pilot interpretation of the information presented). A limited amount of research has been conducted on the design of electronic chart systems for instrument approach procedure (IAP) charts. The results have indicated that not all of the information printed currently on paper IAP charts is needed to fly instrument approaches. Current issues in electronic chart design are discussed in this report. Results from a study that compared three alternative design formats are also provided. Based on the findings from this study, it was determined that electronic charts are a benefit to pilot situation awareness. Newer design formats that use small amounts of display space are also presented.
DTIC
Air Navigation; Charts; Cockpits; Display Devices; Electronic Spectra; Human Factors Engineering; Information Processing (biology); Instrument Approach; Mental Performance; Navigation Aids;

N96-14892# National Aerospace Lab., Tokyo (Japan). Control System Div.
A preliminary flight evaluation of DGPS-INS hybrid navigation system
Shingu, Hirokimi; Murata, Masaaki; Harigae, Masatoshi; Tsujii, Toshiaki; Ono, Takatsugu; Ishikawa, Kazutoshi; and Miyazawa, Yoshikazu; 1 Mar. 1995 12 p (ISSN 0389- 4010)
Report No.(s): (NAL-TR-1262T; NIPS-95-06136) Avail: CASI HC A03/MF A01

This paper summarizes the flight evaluation of the DGPS-INS hybrid navigation system conducted as a preliminary study for constructing a next-generation navigation system at the National Aerospace Laboratory (NAL). First, the configuration used in the flight experiments, including ground facilities and the measurement systems, is described.

Secondly, the design concept for a method of estimating navigation errors using a Kalman filter is presented. Thirdly, flight profiles employed in the experiments are defined and the experimental results of GPS, DGPS, and INS in both stand-alone and hybrid modes which correspond to each profile are shown. Also, improvement in navigation performance by introducting the DGPS-INS hybrid navigation system was experimentally verified. In conclusion, the design concept for the DGPS-INS hybrid navigation system has been successfully completed and the system is now available for use with future space vehicles.
Author
Electronic Equipment Tests; Flight Tests; Global Positioning System; Hybrid Navigation Systems; Inertial Navigation; Kalman Filters; Performance Tests;

N96-15086# Federal Aviation Administration, Cambridge, MA.
The effect of instrument approach procedure chart design on pilot search speed and response accuracy: Flight test results Final Report
Osborne, D. W.; Huntley, Jr., M. S.; Turner, J. W.; and Donovan, C. M.; Jun. 1995 91 p
Report No.(s): (AD-A298130; DOT-VNTSC-FAA-95-13) Avail: CASI HC A05/MF A01

Instrument approach procedure (IAP) charts can be densely packed with information. This high information density can make information difficult to find, particularly in a poorly lit cockpit during turbulence. The Volpe Center's Cockpit Human Factors Program conducted a series of evaLuations to format IAP chart information to more closely conform to the way pilots actually use the information. All of this work has contributed to the evolution of the VoLpe prototype lAP chart format. The prototype's major design features are the briefing strip and iconic missed approach procedure instructions. The briefing strip consists of three rows of tabulated information at the top of the chart. This feature is designed primarily for use in preparing for the approach. Each information eLement is given in the order in which it will be used. The piLot no longer has to search through the entire chart to assemble this data. In the profile view, the 'up and out' portion of the missed approach instructions is depicted in icons rather than text. This critical information is more easily located than if it were embedded in text. The objective of this study was to determine if the prototype IAP chart format would allow pilots to find information faster and more accurately during actual flight. Ten licensed piLots rated for instrument flight participated as subjects in this experiment. Each of the approaches were depicted in two chart formats: National Ocean Service (NOS) and the VoLpe prototype. Pilots took advantage of the prototype's briefing strip to search for information to answer questions.
DTIC
Aircraft Landing; Charts; Flight Tests; Human Factors Engineering; Information Retrieval; Instrument Approach; Pilot Performance; Procedures;

N96-15860*# Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA.
The application of spaceborne GPS to atmospheric limb sounding and global change monitoring
Melbourne, W. G.; Davis, E. S.; Duncan, C. B.; Hajj, G. A.; Hardy, K. R.; Kursinski, E. R.; Meehan, T. K.; Young, L. E.; and Yunck, T. P.; 16 Jun. 1994 158 p
Contract(s)/Grant(s): (NAS7-1260)
Report No.(s): (NASA-CR-199799; NAS 1.26:199799; JPL-PUBL-94-18; NIPS-95-06497) Avail: CASI HC A08/MF A02

This monograph is intended for readers with minimal background in radio science who seek a relatively comprehensive treatment of the mission and technical aspects of an Earth-orbiting radio occultation satellite. Part 1 (chapters 1-6) describes mission concepts and programmatic information; Part 2 (chapters 7-12) deals with the theoretical aspects of analyzing and interpreting radio occultation measurements. In this mission concept the navigation signals from a Global Positioning System (GPS) satellite that is being occulted by the Earth's limb are observed by a GPS flight receiver on board a low Earth orbiter (LEO) satellite. This technique can be used to recover profiles of the Earth's atmospheric refractivity, pressure, and temperature using small, dedicated, and relatively low-cost space systems. Chapter 2 summarizes the basic space system concepts of the limb-sounding technique and describes a low-cost strawman demonstration mission. Chapter 3 discusses some of the scientific benefits of using radio occultation on a suite of small satellites. Chapter 4 provides a more detailed discussion of several system elements in a radio occultation mission, including the launch system for small payloads, the LEO microsat, the GPS constellation, the GPS flight receiver payload, the mission operations ground control and data receiving system, the ground-based GPS global tracking network for precision orbit determination, and the central data processing and archive system. Chapter 5 addresses the various technology readiness questions that invariably arise. Chapter 6 discusses the overall costs of a demonstration mission such as GPS/MET (meteorological) proposed by the University Navstar Consortium (UNAVCO). Chapter 7 describes a geometrical optics approach to coplanar atmospheric occultation. Chapter 8 addresses major questions regarding accuracy of the occultation techniques. Chapter 9 describes some simulations that have been performed to evaluate the sensitivity of the recovered profiles of atmospheric parameters to different error sources, such as departure from spherical symmetry, water vapor, etc. Chapter 10 discusses horizontal and vertical resolution associated with limb sounders in general. Chapter 11 treats selected Fresnel diffraction techniques that can be used in radio occultation

measurements to sharpen resolution. Chapter 12 provides brief discussions on selected special topics, such as strategies for handling interference and multipath processes that may arise for rays traveling in the lower troposphere.
Derived from text
Atmospheric Sounding; Earth Limb; Global Positioning System; Low Earth Orbits; Meteorological Parameters; Meteorological Satellites; Mission Planning; Radio Occultation; Satellite Sounding; Small Scientific Satellites;

N96-16023# Sandia National Labs., Albuquerque, NM.
Plot-flight user's manual, version 1.0
Tenney, J. L.; Aug. 1995 41 p
Contract(s)/Grant(s): (DE-AC04-94AL-85000)
Report No.(s): (DE95-017634; SAND-95-1819) Avail: CASI HC A03/MF A01

DOE contracted with Sandia to install a radar acquisition system (RAMS) to gather aircraft flight data near the Pantex Plant in Amarillo, TX. To support this effort, data reduction tools were needed to help analyze the radar data. Plot-flight is one of several data reduction tools that comprise the Sandia Airspace Recording System (SARS). The radar data is needed to support the Pantex Environmental Impact Study. Plot-flight is a DOS-based plot program that allows analysts to replay pre-recorded air traffic over Albuquerque and Amarillo. The program is flexible enough to permit replay of daily flights either sequentially, by range, or by Beacon ID. In addition to replay, the program is setup for data entry. Analysts can correlate electronic aircraft flight data to the green strip flights logs obtained from the local air traffic control center. The green strips are used by air traffic controllers to record each scheduled flight. The green strips have information not available electronically such as aircraft type and aircraft ID. This type of information is necessary to accommodate the current models used in aircraft crash analysis. Plot-flight correlates the hand-written information from the green strips to the recorded aircraft flight.
DOE
Air Traffic; Air Traffic Control; Data Acquisition; Data Reduction; Electronic Aircraft; Flight Operations; Radar Data; User Manuals (computer Programs);

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

N96-14218 Academia Sinica, Beijing (China). Inst. of Mechanics.
Characteristics and microstructure in the evolution of shear localization in Ti-6Al-4V alloy
Bai, Y. L.; Xue, Q.; Xu, Y.; and Shen, L.; 1995 12 p Prepared in cooperation with Academia Sinica, Shenyang, China, and Inst. of Scientific and Technical Information of China, Beijing, China
Report No.(s): (PB95-246823; ISTIC-TR-95021) Avail: Issuing Activity (National Technical Information Service (NTIS))

A new interrupting method was proposed and the split Hopkinson torsional bar (SHTB) was modified in order to eliminate the effect of loading reverberation on post-mortem observations. This makes the comparative study of macro- and microscopic observations on tested materials and relevant transient measurement tau-gamma curve possible. The experimental results of the evolution of shear localization in Ti-6Al-4V alloy studied with the modified SHTB are reported in the paper. The collapse of shear stress seems to be closely related to the appearance of a certain critical coalescence of microcracks.
NTIS
Aluminum Alloys; Fatigue (materials); Microstructure; Shear Stress; Titanium Alloys; Torsional Stress; Vanadium Alloys;

N96-14615# National Aerospace Lab., Tokyo (Japan). Airframe Div.
Ground vibration test of the NAL Dornier 228-200 flight research airplane
Ando, Yasukatsu; Minegishi, Masakatsu; Hashidate, Masataka; Saitoh, Kenichi; Fujii, Kenji; and Matsushita, Hiroshi; 1 Feb. 1995 23 p In JAPANESE (ISSN 0389-4010)
Report No.(s): (NAL-TR-1259; NIPS-95-06134) Avail: CASI HC A03/MF A01

The National Aerospace Laboratory (NAL) is preparing to conduct flight tests for gust load alleviation technology using an experimental airplane. The structural characteristics of the airplane are needed to design the gust load alleviation system. Ground Vibration Tests (GVT) of the Dornier 228-200 airplane were carried out for one month, starting March 15, 1994. In this paper, the GVT results and tests are described.
Author
Aerodynamic Characteristics; Flight Tests; Ground Tests; Gust Loads; Research Aircraft; Structural Analysis; Vibration Tests;

N96-15429# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
Improvements in design oriented equivalent plate modeling of wing structures M.S. Thesis
Borchert, Robert Quinn; Mar. 1995 177 p
Report No.(s): (AD-A298560; AFIT/CI/CIA-95-029) Avail: CASI HC A09/MF A02

Improvements in equivalent plate modeling of aircraft wings are presented. Formulations for wing mass, stiffness, and loads using Classical Plate Theory and First Order Shear Deformation Plate Theory are given in a general manner al-

lowing versatility in the selection of displacement Ritz polynomials. A new technique for approximating the stiffness of an array of spar webs with the stiffness of an equivalent sandwich core is developed. A formulation allowing wing zones modeled with Classical Plate Theory and First Order Shear Deformation Plate Theory to be used together is also presented. Numerical tests were performed to verify the validity of the new formulations. Tests of a thick, high aspect ratio wing showed that selecting low order Ritz polynomials for the linear in-plane displacements of a symmetric wing can lead to a significant reduction in model order while retaining acceptable accuracy. Additional tests of the thick, high aspect ratio wing and a typical supersonic transport wing showed that an array of spar webs may be accurately replaced by an equivalent core leading to substantial savings in computation time.
DTIC
Aerodynamic Configurations; Aspect Ratio; Design Analysis; Loads (forces); Stiffness; Wings;

N96-15626*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
Soil runway friction evaluation in support of USAF C-17 transport aircraft operations
Yager, Thomas J.; 1 Oct. 1995 22 p
Contract(s)/Grant(s): (RTOP 505-63-50-19)
Report No.(s): (NASA-TM-110194; NAS 1.15:110194; NIPS-95-06403) Avail: CASI HC A03/MF A01

A series of NASA Diagonal-Braked Vehicle (DBV) test runs were performed on the soil runway 7/25 at Holland landing zone, Fort Bragg, North Carolina, near Pope Air Force Base in March 1995 at the request of the Air Force C-17 System Program Office. These ground vehicle test results indicated that the dry runway friction level was suitable for planned C-17 transport aircraft landing and take-off operations at various gross weights. These aircraft operations were successfully carried out. On-board aircraft deceleration measurements were comparable to NASA DBV measurements. Additional tests conducted with an Army High Mobility Multi-Purpose Wheeled Vehicle equipped with a portable decelerometer, showed good agreement with NASA DBV data.
Author
Aircraft Landing; C-17 Aircraft; Deceleration; Friction; Runway Conditions; Runways;

N96-15637*# Old Dominion Univ., Norfolk, VA. Dept. of Aerospace Engineering.
Wing-section optimization for supersonic viscous flow
Item, Cem C.; and Baysal, Oktay; ed. 17 Nov. 1995 4 p
Repr. from CFD for Design and Optimization, FED-v. 232, 1995 p 29 Presented at the 1995 ASME International Mechanical Engineering Congress and Exposition, San Francisco, CA, United States, 12-17 Nov. 1995
Contract(s)/Grant(s): (NAG1-1576)
Report No.(s): (NASA-CR-199746; NAS 1.26:199746; NIPS-95-06438) Avail: CASI HC A01/MF A01; Abstract Only

To improve the shape of a supersonic wing, an automated method that also includes higher fidelity to the flow physics is desirable. With this impetus, an aerodynamic optimization methodology incorporating thin-layer Navier-Stokes equations and sensitivity analysis had been previously developed. Prior to embarking upon the wind design task, the present investigation concentrated on testing the feasibility of the methodology, and the identification of adequate problem formulations, by defining two-dimensional, cost-effective test cases. Starting with two distinctly different initial airfoils, two independent shape optimizations resulted in shapes with similar features: slightly cambered, parabolic profiles with sharp leading- and trailing-edges. Secondly, the normal section to the subsonic portion of the leading edge, which had a high normal angle-of-attack, was considered. The optimization resulted in a shape with twist and camber which eliminated the adverse pressure gradient, hence, exploiting the leading-edge thrust. The wing section shapes obtained in all the test cases had the features predicted by previous studies. Therefore, it was concluded that the flowfield analyses and sensitivity coefficients were computed and fed to the present gradient-based optimizer correctly. Also, as a result of the present two-dimensional study, suggestions were made for the problem formulations which should contribute to an effective wing shape optimization.
Author
Aerodynamic Configurations; Aircraft Design; Airfoils; Computational Fluid Dynamics; Computer Aided Design; Mathematical Models; Navier-stokes Equation; Supersonic Flow; Two Dimensional Models; Viscous Flow;

N96-15638*# Old Dominion Univ., Hampton, VA.
Three-dimensional aerodynamic shape optimization using discrete sensitivity analysis
Burgreen, Gregory W.; 1 Jan. 1995 2 p
Contract(s)/Grant(s): (NAG1-1576)
Report No.(s): (NASA-CR-199788; NAS 1.26:199788; NIPS-95-06439) Avail: CASI HC A01/MF A01; Abstract Only

An aerodynamic shape optimization procedure based on discrete sensitivity analysis is extended to treat three-dimensional geometries. The function of sensitivity analysis is to directly couple computational fluid dynamics (CFD) with numerical optimization techniques, which facilitates the construction of efficient direct-design methods. The development of a practical three-dimensional design procedures entails many challenges, such as: (1) the demand for significant efficiency improvements over current design methods; (2) a general and flexible three-dimensional surface representation; and (3) the efficient solution of very large systems

of linear algebraic equations. It is demonstrated that each of these challenges is overcome by: (1) employing fully implicit (Newton) methods for the CFD analyses; (2) adopting a Bezier-Bernstein polynomial parameterization of two- and three-dimensional surfaces; and (3) using preconditioned conjugate gradient-like linear system solvers. Whereas each of these extensions independently yields an improvement in computational efficiency, the combined effect of implementing all the extensions simultaneously results in a significant factor of 50 decrease in computational time and a factor of eight reduction in memory over the most efficient design strategies in current use. The new aerodynamic shape optimization procedure is demonstrated in the design of both two- and three-dimensional inviscid aerodynamic problems including a two-dimensional supersonic internal/external nozzle, two-dimensional transonic airfoils (resulting in supercritical shapes), three-dimensional transport wings, and three-dimensional supersonic delta wings. Each design application results in realistic and useful optimized shapes.
Author

Aerodynamic Configurations; Aircraft Design; Airfoils; Computational Fluid Dynamics; Computational Fluid Dynamics; Computer Aided Design; Delta Wings; Discrete Functions; Sensitivity; Supercritical Wings; Supersonic Nozzles;

N96-15639*# Old Dominion Univ., Norfolk, VA.
Wing-section optimization for supersonic viscous flows
Item, Cem C.; 1 Jan. 1995 2 p
Contract(s)/Grant(s): (NAG1-1576)
Report No.(s): (NASA-CR-199747; NAS 1.26:199747; NIPS-95-06440) Avail: CASI HC A01/MF A01; Abstract Only

The recent interest in High Speed Civil Transport (HSCT) has resulted in renewed research studies of optimized supersonic cruise transport configurations. Incorporation of flow viscosity effects in the design process of such a supersonic wing is currently under investigation. This may lead to more accurate problem formulations and, in turn, greater aerodynamic efficiency than can be obtained by the traditional, inviscid, linear theories. In this context, for a design code to be a candidate for a complex optimization problem, such as three-dimensional viscous supersonic wing design, it should be validated using simpler building-block shapes. To optimize the shape of a supersonic wing, an automated method that also includes higher fidelity to the flow physics is desirable. With this impetus, an aerodynamic optimization methodology incorporating Navier-Stokes equations and sensitivity analysis had been previously developed. Prior to embarking upon the wing design task, the present investigation concentrated on testing the flexibility of the methodology, and the identification of adequate problem formulations, by defining two-dimensional, cost-effective test cases. Starting with two distinctly different initial airfoils, two independent shape optimizations resulted in shapes with very similar features. Secondly, the normal section to the subsonic portion of the leading edge, which had a high normal angle-of-attack, was considered. The optimization resulted in a shape with twist and camber, which eliminated the adverse pressure gradient, hence, exploiting the leading-edge thrust. The wing section shapes obtained in all the test cases had the features predicted by previous studies. Therefore, it was concluded that the flowfield analyses and the sensitivity coefficients were computed and fed to the present gradient-based optimizer correctly. Also, as a result of the present two-dimensional study, suggestions were made for problem formulations which should contribute to an effective wing shape optimization.
Author

Aerodynamic Characteristics; Aerodynamic Configurations; Aircraft Design; Airfoils; Applications Programs (computers); Computational Fluid Dynamics; Inviscid Flow; Navier-stokes Equation; Optimization; Supersonic Flow; Viscous Flow;

N96-15640*# Old Dominion Univ., Norfolk, VA. Dept. of Aerospace Engineering.
Aerodynamic shape optimization directed toward a supersonic transport using sensitivity analysis Final Report, period ended 15 Aug. 1995
Baysal, Oktay; 1 Nov. 1995 8 p
Contract(s)/Grant(s): (NAG1-1576)
Report No.(s): (NASA-CR-199748; NAS 1.26:199748; NIPS-95-06441) Avail: CASI HC A02/MF A01

This investigation was conducted from March 1994 to August 1995, primarily, to extend and implement the previously developed aerodynamic design optimization methodologies for the problems related to a supersonic transport design. These methods had demonstrated promise to improve the designs (more specifically, the shape) of aerodynamic surfaces, by coupling optimization algorithms (OA) with Computational Fluid Dynamics (CFD) algorithms via sensitivity analyses (SA) with surface definition methods from Computer Aided Design (CAD). The present extensions of this method and their supersonic implementations have produced wing section designs, delta wing designs, cranked-delta wing designs, and nacelle designs, all of which have been reported in the open literature. Despite the fact that these configurations were highly simplified to be of any practical or commercial use, they served the algorithmic and proof-of-concept objectives of the study very well. The primary cause for the configurational simplifications, other than the usual simplify-to-study the fundamentals reason, were the premature closing of the project. Only after the first of the originally intended three-year term, both the funds and the computer resources supporting the project were abruptly cut due to their severe shortages at the funding agency. Nonetheless, it was shown that the extended methodologies could

be viable options in optimizing the design of not only an isolated single-component configuration, but also a multiple-component configuration in supersonic and viscous flow. This allowed designing with the mutual interference of the components being one of the constraints all along the evolution of the shapes.
Derived from text
Aerodynamic Configurations; Aircraft Design; Algorithms; Computational Fluid Dynamics; Computer Aided Design; Design Analysis; Optimization; Shapes; Supersonic Flow; Viscous Flow;

N96-15746*# Old Dominion Univ., Norfolk, VA.
Implementation of a multiblock sensitivity analysis method in numerical aerodynamic shape optimization
Lacasse, James M.; 1 Jan. 1995 2 p
Report No.(s): (NASA-CR-199784; NAS 1.26:199784; NIPS-95-06445) Avail: CASI HC A01/MF A01; Abstract Only

A multiblock sensitivity analysis method is applied in a numerical aerodynamic shape optimization technique. The Sensitivity Analysis Domain Decomposition (SADD) scheme which is implemented in this study was developed to reduce the computer memory requirements resulting from the aerodynamic sensitivity analysis equations. Discrete sensitivity analysis offers the ability to compute quasi-analytical derivatives in a more efficient manner than traditional finite-difference methods, which tend to be computationally expensive and prone to inaccuracies. The direct optimization procedure couples CFD analysis based on the two-dimensional thin-layer Navier-Stokes equations with a gradient-based numerical optimization technique. The linking mechanism is the sensitivity equation derived from the CFD discretized flow equations, recast in adjoint form, and solved using direct matrix inversion techniques. This investigation is performed to demonstrate an aerodynamic shape optimization technique on a multiblock domain and its applicability to complex geometries. The objectives are accomplished by shape optimizing two aerodynamic configurations. First, the shape optimization of a transonic airfoil is performed to investigate the behavior of the method in highly nonlinear flows and the effect of different grid blocking strategies on the procedure. Secondly, shape optimization of a two-element configuration in subsonic flow is completed. Cases are presented for this configuration to demonstrate the effect of simultaneously reshaping interfering elements. The aerodynamic shape optimization is shown to produce supercritical type airfoils in the transonic flow from an initially symmetric airfoil. Multiblocking effects the path of optimization while providing similar results at the conclusion. Simultaneous reshaping of elements is shown to be more effective than individual element reshaping due to the inclusion of mutual interference effects.
Author
Aerodynamic Characteristics; Aerodynamic Configurations; Computational Fluid Dynamics; Decomposition; Multigrid Methods; Navier-stokes Equation; Sensitivity; Supercritical Airfoils; Trajectory Optimization;

N96-16096*# Old Dominion Univ., Norfolk, VA. Faculty of Engineering.
Design of 3-D nacelle near flat-plate wing using multiblock sensitivity analysis (ADOS)
Eleshaky, Mohamed E.; (Alexandria Univ., Egypt.)and Baysal, Oktay; (American Inst. of Aeronautics and Astronautics, Washington, DC.) Washington, DC United States American Inst. of Aeronautics and Astronautics 1 Jan. 1994 1 p
Contract(s)/Grant(s): (NAG1-1576)
Report No.(s): (NASA-CR-199745; NAS 1.26:199745; AIAA PAPER 94-0160; NIPS-95-06457) Avail: CASI HC A01/MF A01; Abstract Only

One of the major design tasks involved in reducing aircraft drag is the integration of the engine nacelles and airframe. With this impetus, nacelle shapes with and without the presence of a flat-plate wing nearby were optimized. This also served as a demonstration of the 3-D version of the recently developed aerodynamic design optimization methodology using sensitivity analysis, ADOS. The required flow analyses were obtained by solving the three-dimensional, compressible, thin-layer Navier-Stokes equations using an implicit, upwind-biased, finite volume scheme. The sensitivity analyses were performed using the preconditioned version of the SADD scheme (sensitivity analysis on domain decomposition). In addition to demonstrating the present method's capability for automatic optimization, the results offered some insight into two important issues related to optimizing the shapes of multicomponent configurations in close proximity. First, inclusion of the mutual interference between the components resulted in a different shape as opposed to shaping an isolated component. Secondly, exclusion of the viscous effects compromised not only the flow physics but also the optimized shapes even for isolated components.
Author
Aircraft Design; Design Analysis; Drag Reduction; Nacelles; Wing Nacelle Configurations;

N96-16145*# Old Dominion Univ., Norfolk, VA. School of Mechanical and Aerospace Engineering.
Three-dimensional aerodynamic shape optimization of supersonic delta wings
Burgreen, Greg W.; and Baysal, Oktay; 9 Sep. 1994 2 p
Presented at the 5th AIAA/USAF/NASA/ISSMO Symposium on Multidisciplinary Analysis and Optimization, Panama City, FL, United States, 7-9 Sep. 1994
Contract(s)/Grant(s): (NAG1-1576)
Report No.(s): (NASA-CR-199744; NAS 1.26:199744;

AIAA PAPER 94-4271; NIPS-95-06437) Copyright Avail: CASI HC A01/MF A01; Abstract Only

A recently developed three-dimensional aerodynamic shape optimization procedure AeSOP(sub 3D) is described. This procedure incorporates some of the most promising concepts from the area of computational aerodynamic analysis and design, specifically, discrete sensitivity analysis, a fully implicit 3D Computational Fluid Dynamics (CFD) methodology, and 3D Bezier-Bernstein surface parameterizations. The new procedure is demonstrated in the preliminary design of supersonic delta wings. Starting from a symmetric clipped delta wing geometry, a Mach 1.62 asymmetric delta wing and two Mach 1. 5 cranked delta wings were designed subject to various aerodynamic and geometric constraints.

Author

Aerodynamic Configurations; Aircraft Design; Applications Programs (computers); Computational Fluid Dynamics; Design Analysis; Discrete Functions; Multidisciplinary Design Optimization; Sensitivity; Three Dimensional Models;

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

N96-15395 Air Force Materiel Command, Wright-Patterson AFB, OH.

B-1 oxygen analyzer operational tests

Assink, Warren; May 1995 59 p Limited Reproducibility: More than 20% of this document may be affected by poor print

Report No.(s): (AD-A297358; AFMC-95-R-03; AFMC- 94-P-102) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

In January 1990, the 3-1 System Program Office and AFMC's Productivity, Reliability and Maintenance (PRAM) Office requested AFPTEF's assistance on testing a replacement oxygen analyzer. B-1 aircraft have an onboard generator which supplies oxygen for the crew. Field maintenance uses a current oxygen equipment tolerance. The existing oxygen analyzer currently exhibits high failure rates, an inability to measure flow, and requires complex mathematical calculations to determine readings. The Program and PRAM office contracted with Aeronautical Systems Center's Fabrication Facility at Wright-Patterson to develop a replacement that would be more user friendly for maintenance personnel. AFPTEF used its equipment to determine if the analyzer complies with military test transportation, handling and operational specification for lightweight equipment.

DTIC

B-1 Aircraft; Oxygen Analyzers; Performance Tests; Temperature Effects;

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

N96-14931# Michigan Univ., Ann Arbor, MI. Dept. of Aerospace Engineering.

AFOSR contractors meeting in airbreathing combustion

Tishkoff, J. M.; 19 Jun. 1995 154 p Meeting held in Ann Arbor, MI, 13-15 Jun. 1995

Contract(s)/Grant(s): (AF PROJ. 2308)

Report No.(s): (AD-A298274) Avail: CASI HC A08/MF A02

Abstracts are given for research in airbreathing combustion and propulsion diagnostics supported by the Air Force Office of Scientific Research (AFOSR).

DTIC

Air Breathing Engines; Combustion; Conferences; Propulsion System Performance;

N96-15200*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

Rapid numerical simulation of viscous axisymmetric flow fields

Tweedt, Daniel L.; and Chima, Rodrick V.; 1 Nov. 1995 20p Presented at the 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996; sponsored by AIAA

Contract(s)/Grant(s): (RTOP 505-62-10)

Report No.(s): (NASA-TM-107103; NAS 1.15:107103; AIAA PAPER 96-0449; E-10001; NIPS-95-06277) Avail: CASI HC A03/MF A01

A two-dimensional Navier-Stokes code has been developed for rapid numerical simulation of axisymmetric flow fields, including flow fields with an azimuthal velocity component. The azimuthal-invariant Navier-Stokes equations in a cylindrical coordinate system are mapped to a general body-fitted coordinate system, with the streamwise viscous terms then neglected by applying the thin-layer approximation. Turbulence effects are modeled using an algebraic model, typically the Baldwin-Lomax turbulence model, although a modified Cebeci-Smith model can also be used. The equations are discretized using central finite differences and solved using a multistage Runge-Kutta algorithm with a spatially varying time step and implicit residual smoothing. Results are presented for calculations of supersonic flow over a waisted body-of-revolution, transonic flow through a normal shock wave in a straight circular duct of constant cross sectional area, swirling supersonic (inviscid) flow through a strong shock in a straight radial duct, and swirling subsonic flow in an annular-to-circular diffuser duct. Comparisons between computed and experimental results are in fair to good agreement, demonstrating that the viscous code

can be a useful tool for practical engineering design and analysis work.
Author
Axisymmetric Flow; Computational Fluid Dynamics; Finite Difference Theory; Flow Distribution; Navier-stokes Equation; Pressure Distribution; Runge-kutta Method; Shock Waves; Transonic Flow; Turbulence Models; Viscous Flow;

N96-15327*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
An optimized integrator windup protection technique applied to a turbofan engine control
Watts, Stephen R.; (United Technologies Corp., West Palm Beach, FL.)and Garg, Sanjay; 1 Oct. 1995 13 p
Contract(s)/Grant(s): (NAS3-26618; RTOP 505-62-50)
Report No.(s): (NASA-TM-107035; NAS 1.15:107035; E-9855; NIPS-95-06274) Avail: CASI HC A03/MF A01

This paper introduces a new technique for providing memoryless integrator windup protection which utilizes readily available optimization software tools. This integrator windup protection synthesis provides a concise methodology for creating integrator windup protection for each actuation system loop independently while assuring both controller and closed loop system stability. The individual actuation system loops' integrator windup protection can then be combined to provide integrator windup protection for the entire system. This technique is applied to an H(exp infinity) based multivariable control designed for a linear model of an advanced afterburning turbofan engine. The resulting transient characteristics are examined for the integrated system while encountering single and multiple actuation limits.
Author
Circuit Protection; Control Systems Design; Digital Integrators; Engine Control; Integrators; Multivariable Control; Power Factor Controllers; Propulsion System Configurations; Systems Engineering; Turbofan Engines;

N96-15339# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
Recommended practices for the assessment of the effects of atmospheric water ingestion on the performance and operability of gas turbine engines [Recommandations concernant les methodes a utiliser pour le traitement de lhumidite dans les turbines a gaz]
1 Sep. 1995 364 p
Report No.(s): (AGARD-AR-332; ISBN-92-836-1022-9; NIPS-95-06172) Avail: CASI HC A16/MF A03

The ingestion of water from the atmosphere into the inlet of a gas turbine can significantly influence the performance and operability of the engine. The objective of this report is to identify preferred practices to measure the effect of water ingestion on engine performance and operability. Atmospheric water is considered in all its forms; gaseous humidity, condensation droplets, rain, snow, and hail. The Introduction to Chapter 1 summarizes the purpose and background to the report and identifies the intended audience. Chapter 2 provides a quantitative assessment of the hazardous weather threat due to water for all types of aircraft using data collected from international sources. Chapters 3, 4, and 5 examine analytical and experimental techniques currently in use to measure and to predict the effects of the different forms of ingested water on engine performance and operability. Chapter 6 summarizes current acceptance and certification specifications used by different national agencies in assessing the effects of ingested water. In Chapter 7 a review is made of current instrumentation used to assess and quantify the presence of vapor, liquid droplets, and particles (frozen droplets) in the flow. Chapter 8 describes briefly current methods for testing gas turbine engines under typical weather threat conditions. The final chapter of the report summarizes the collected information on the effects of water ingestion from the preceding chapters and presents a set of conclusions and recommendations for future research.
Author
Atmospheric Moisture; Condensation; Drops (liquids); Engine Inlets; Flight Hazards; Gas Turbine Engines; Ingestion (engines); Performance; Water Vapor;

N96-16044# Battelle Memorial Inst., Wright-Patterson AFB, OH. Applied Technical Computer Group.
Acquisition and reduction of rotor-tip static pressure transducer data from a low aspect ratio transonic fan Final Report, Jun. 1993 - Feb. 1994
Russler, Patrick M.; Feb. 1995 37 p
Contract(s)/Grant(s): (F33615-91-D-2162)
Report No.(s): (AD-A298568; WL-TR-95-2022) Avail: CASI HC A03/MF A01

This report details the acquisition and reduction of Over-The-Rotor (OTR) static pressure data. These data were acquired during the Augmented Damping of Low Aspect Ratio Fans (ADLARF) test conducted at the Compressor Research Facility (CRF). The CRF is located at Wright Laboratory on Wright-Patterson A.F.B. in Ohio. The CRF is one of two high-speed compressor test facilities at Wright Laboratory. The report is primarily concerned with the acquisition and reduction of the OTR data, and is intended to demonstrate the ability to reduce, display, and analyze static pressure data acquired from the tip region of fans and compressors. The ability to show basic shock structure in the tip region of a transonic fan is clearly demonstrated. Problems associated with the acquisition and reduction process are also addressed. Although these data were originally intended only to demonstrate proof of concept, they have also provided valuable insight concerning the tip flow region of the ADLARF fan.
DTIC

Blade Tips; Compressor Rotors; Data Acquisition; Data Reduction; Flow Distribution; Low Aspect Ratio; Pressure Measurement; Rotor Aerodynamics; Static Pressure; Transonic Flow; Turbocompressors;

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N96-15195*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

Moving base simulation of an ASTOVL lift-fan aircraft

Chung, William W. Y.; Borchers, Paul F.; and Franklin, James A.; 1 Aug. 1995 60 p

Contract(s)/Grant(s): (RTOP 505-68-32)

Report No.(s): (NASA-TM-110365; NAS 1.15:110365; A-950090; NIPS-95-06261) Avail: CASI HC A04/MF A01

Using a generalized simulation model, a moving-base simulation of a lift-fan short takeoff/vertical landing fighter aircraft was conducted on the Vertical Motion Simulator at Ames Research Center. Objectives of the experiment were to (1) assess the effects of lift-fan propulsion system design features on aircraft control during transition and vertical flight including integration of lift fan/lift/cruise engine/aerodynamic controls and lift fan/lift/cruise engine dynamic response, (2) evaluate pilot-vehicle interface with the control system and head-up display including control modes for low-speed operational tasks and control mode/display integration, and (3) conduct operational evaluations of this configuration during takeoff, transition, and landing similar to those carried out previously by the Ames team for the mixed-flow, vectored thrust, and augmentor-ejector concepts. Based on results of the simulation, preliminary assessments of acceptable and borderline lift-fan and lift/cruise engine thrust response characteristics were obtained. Maximum pitch, roll, and yaw control power used during transition, hover, and vertical landing were documented. Control and display mode options were assessed for their compatibility with a range of land-based and shipboard operations from takeoff to cruise through transition back to hover and vertical landing. Flying qualities were established for candidate control modes and displays for instrument approaches and vertical landings aboard an LPH assault ship and DD-963 destroyer. Test pilot and engineer teams from the Naval Air Warfare Center, Boeing, Lockheed, McDonnell Douglas, and the British Defence Research Agency participated in the program.

Author

Aircraft Control; Computerized Simulation; Dynamic Response; Engine Control; Fighter Aircraft; Flight Characteristics; Lift; Lift Fans; Man Machine Systems; Propulsion System Performance; Stovl Aircraft;

N96-16098*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH. Vehicle Propulsion Directorate.

Adaptive optimization of aircraft engine performance using neural networks

Simon, Donald L.; (Army Research Lab., Cleveland, OH.)and Long, Theresa W.; (NeuroDyne, Inc., Williamsburg, VA.) 1 Nov. 1995 14 p Presented at the 86th Symposium on Advanced Aero Engines Concepts and Controls, Bellevue, WA, United States, 25-29 Sep. 1995; sponsored by AGARD

Contract(s)/Grant(s): (NAS3-27250; RTOP 244-02-01)

Report No.(s): (NASA-TM-107110; NAS 1.15:107110; E-10015; ARL-TR-765; NIPS-95-06490) Avail: CASI HC A03/MF A01

Preliminary results are presented on the development of an adaptive neural network based control algorithm to enhance aircraft engine performance. This work builds upon a previous National Aeronautics and Space Administration (NASA) effort known as Performance Seeking Control (PSC). PSC is an adaptive control algorithm which contains a model of the aircraft's propulsion system which is updated on-line to match the operation of the aircraft's actual propulsion system. Information from the on-line model is used to adapt the control system during flight to allow optimal operation of the aircraft's propulsion system (inlet, engine, and nozzle) to improve aircraft engine performance without compromising reliability or operability. Performance Seeking Control has been shown to yield reductions in fuel flow, increases in thrust, and reductions in engine fan turbine inlet temperature. The neural network based adaptive control, like PSC, will contain a model of the propulsion system which will be used to calculate optimal control commands on-line. Hopes are that it will be able to provide some additional benefits above and beyond those of PSC. The PSC algorithm is computationally intensive, it is valid only at near steady-state flight conditions, and it has no way to adapt or learn on-line. These issues are being addressed in the development of the optimal neural controller. Specialized neural network processing hardware is being developed to run the software, the algorithm will be valid at steady-state and transient conditions, and will take advantage of the on-line learning capability of neural networks. Future plans include testing the neural network software and hardware prototype against an aircraft engine simulation. In this paper, the proposed neural network software and hardware is described and preliminary neural network training results are presented.

Author

Adaptive Control; Aircraft Engines; Algorithms; Computer Aided Design; Engine Control; Engine Design; Mathematical Models; Neural Nets; On-line Systems; Optimal Control; Propulsion System Performance; Software Engineering;

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

N96-14501# National Aerospace Lab., Tokyo (Japan).
Flight simulation model for automatic landing flight experiment. Part 1: Free flight and ground run basic model
30 Aug. 1994 109 p In JAPANESE and ENGLISH (ISSN 0389-4010)
Report No.(s): (NAL-TR-1252) Avail: CASI HC A06/MF A02

The National Aerospace Laboratory (NAL) and the National Aerospace Development Agency of Japan (NASDA) have been cooperating in the research and technology development of a future unmanned reentry space vehicle named HOPE, an H-2 rocket orbiting plane. ALFLEX, an automatic landing flight experiment, is being prepared as one of the evaluation programs for HOPE key technologies. In the ALFLEX, the subscale model is dropped from a helicopter at an altitude of 1500 m with a velocity of 46 m/s and it automatically lands on a 1000 m runway, and is controlled by an onboard navigation, guidance, and control system. The nominal glide path is 30 degrees and the approach velocity is 80 m/s. This paper discusses an ALFLEX numerical simulation model from the helicopter release to the ground run stop and the preliminary results obtained from its simulation. This numerical simulation program has been a basic tool for the ALFLEX guidance and control system design, and it appropriately presents principal characteristics of the planned reentry space vehicle for its landing/approach phase.
Author
Computerized Simulation; Flight Simulation; Free Flight; Japanese Space Program; Landing Simulation; Reentry Vehicles; Rocket Planes; Spacecraft Landing;

N96-14584 Army Cold Regions Research and Engineering Lab., Hanover, NH.
Sealants and cold regions pavement seals: A review
Ketcham, Stephen A.; May 1995 27 p Limited Reproducibility: More than 20% of this document may be affected by poor print
Contract(s)/Grant(s): (DA PROJ. 4A7-62784-AT-42)
Report No.(s): (AD-A297360; CRREL-95-11) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

A pavement joint seal prevents the passage of liquids into the pavement base and the intrusion of solids into the joint. The primary mechanical requirements of a pavement seal are that it respond elastically or viscoelastically to any movement of the joint without failure and that it withstand indentation of hard objects like rocks. Because pavement joint movements and seal deformations can be large, elastomeric sealants are often used to form seals. Winter conditions are recognized as the most critical for a seal because of the possibility that failure stresses will be reached as the joint opens to a maximum and the material stiffens in response to the temperature reduction. This report reviews the specific problems and requirements that cold climates create for the performance of elastomeric seals. Emphasis is placed on the material response behavior that can lead to failure of a seal. In an attempt to clarity the mechanics of sealant and seal performance associated with low-temperature pavement applications and to address the issue of low-temperature stiffening that should be a dominant factor in the selection of a sealant, this report presents background information on the formulation and mechanical properties of elastomeric seal materials and the structural behavior of field-molded joint and crack seals.
DTIC
Elastic Properties; Elastomers; Low Temperature Environments; Mechanical Properties; Pavements; Sealers; Seals (stoppers);

N96-14896# National Aerospace Lab., Tokyo (Japan).
Large scale hypersonic wind tunnel system: Design and construction
1 Feb. 1995 159 p In JAPANESE Original contains color illustrations (ISSN 0389-4010)
Report No.(s): (NAL-TR-1261; NIPS-95-06203) Avail: CASI HC A08/MF A02

The main characteristics, facilities' outlines, design methodologies, and equipment details are used to describe the National Aerospace Laboratory's (NAL) new hypersonic wind tunnel system now under construction. This system, scheduled to be completed by the end of FY 1994, consists of the existing phi 50 cm tunnel and the new phi 1.27 m leg with a Mach number nozzle of 10. The new leg being constructed parallel to the existing tunnel, which has Mach number nozzles of 5, 7 ,9, and 11, also has daily operational cycles that are approximately 2.5 times greater than those of the old tunnel. The new leg operational conditions are as follows: stagnation conditions of T(O) = 600 to approximately 1200 K and P(O) = 1 to approximately 10 MPa, Mach number of 10, Re = 3 x 10(exp 5) to approximately 4.5 x 10(exp 6)/m and a viscous parameter of V-bar = M/square root of Re = 0.005 to approximately 0. 014. These operational conditions of this NAL hypersonic wind tunnel system could cover the flight conditions of winged space vehicles, such as, the Space Shuttle or the future Japanese unmanned winged reentry vehicle HOPE for M-Re and M-M/square root of Re maps in the Mach number range of M = 5 to approximately 11.
Author
Design Analysis; Flight Conditions; Hypersonic Wind Tunnels; Japan; Mach Number; Wind Tunnel Nozzles; Wind Tunnel Stability Tests;

N96-15221# Sandia National Labs., Albuquerque, NM.
Flight code validation simulator
Sims, Brent A.; 1995 5 p Presented at the Meeting on Physical and Chemical Processes in Combustion, Worcester, MA, 16-18 Oct. 1995
Contract(s)/Grant(s): (DE-AC04-94AL-85000)
Report No.(s): (DE95-015854; SAND-95-1616C; CONF-9510136-1) Avail: CASI HC A01/MF A01

An End-To-End Simulation capability for software development and validation of missile flight software on the actual embedded computer has been developed utilizing a 486 PC, i860 DSP coprocessor, embedded flight computer and custom dual port memory interface hardware. This system allows real-time interrupt driven embedded flight software development and checkout. The flight software runs in a Sandia Digital Airborne Computer (SANDAC) and reads and writes actual hardware sensor locations in which IMU (Inertial Measurements Unit) data resides. The simulator provides six degree of freedom real-time dynamic simulation, accurate real-time discrete sensor data and acts on commands and discretes from the flight computer. This system was utilized in the development and validation of the successful premier flight of the Digital Miniature Attitude Reference System (DMARS) in January 1995 at the White Sands Missile Range on a two stage attitude controlled sounding rocket.
DOE
Airborne/spaceborne Computers; Applications Programs (computers); Computerized Simulation; Embedded Computer Systems; Flight Control; Flight Simulators; Missile Ranges; Program Verification (computers); Real Time Operation; Sounding Rockets;

N96-15627*# Control Dynamics Co., Huntsville, AL.
Mechanisms test bed math model modification and simulation support Final Report, 9 Jul. 1990 - 30 Nov. 1995
Gilchrist, Andrea C.; and Tobbe, Patrick A.; 30 Nov. 1995 63 p
Contract(s)/Grant(s): (NAS8-38771)
Report No.(s): (NASA-CR-199764; NAS 1.26:199764; REPT-TH50050A; NIPS-95-06432) Avail: CASI HC A04/MF A01

This report summarizes the work performed under contract NAS8-38771 in support of the Marshall Space Flight Center Six Degree of Freedom Motion Facility and Flight Robotics Laboratory. The contract activities included the development of the two flexible body and Remote Manipulator System simulations, Dynamic Overhead Target Simulator control system and operating software, Global Positioning System simulation, and Manipulator Coupled Spacecraft Controls Testbed. Technical support was also provided for the Lightning Imaging Sensor and Solar X-Ray Imaging programs. The cover sheets and introductory sections for the documentation written under this contract are provided as an appendix.
Derived from text
Computerized Simulation; Dynamic Control; Mathematical Models; Robot Dynamics; Simulators; Spacecraft Control; Spacecraft Motion;

10 ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

N96-14893# National Aerospace Lab., Tokyo (Japan). Aeroengine Div.
A computer model for the simulation of turbulent reacting flow in a jet assisted ram combustor
Kumar, Sanjiv; 1 May 1995 19 p Original contains color illustrations (ISSN 0389-4010)
Report No.(s): (NAL-TR-1267T; NIPS-95-06139) Avail: CASI HC A03/MF A01

A computer code for the simulation of the turbulent reacting flow in a jet assisted ram combustor is developed. Favre averaged continuity and Navier-Stokes equations, equations for a low Reynolds number k-epsilon model, and equations for mixture fraction and its variance are solved to simulate the turbulent reacting flow. A Stretched Laminar Flamelet Model (SLFM) in the mixture fraction space is used to simulate the combustion of hydrogen and air using a 28-step reaction mechanism with 10 species. The SLFM is coupled to the turbulent flow through density which is calculated using an assumed beta-shaped probability distribution function for mixture fraction and a log-normal probability distribution function for the scalar dissipation. All other mass averaged thermo-chemical variables are computed off-line after a converged solution has been achieved. Solution of the continuity equations and the three momentum equations is achieved using the SIMPLER algorithm. The Linearized system of equations for each variable is solved sequentially using a Incomplete Lower Upper pre-conditioned conjugate gradient method. Simulation results showing the recirculation zones, distribution of species, and temperature are presented.
Author
Applications Programs (computers); Combustion Chambers; Computational Fluid Dynamics; Continuity Equation; K-epsilon Turbulence Model; Laminar Flow; Low Reynolds Number; Navier-stokes Equation; Ramjet Engines; Reacting Flow; Turbulent Combustion; Turbulent Flow;

11 CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

N96-14304* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

Flexible ceramic thermal protection system resistant to high aeroacoustic noise comprising a three-dimensional woven-fiber structure having a multilayer top fabric layer, a bottom fabric layer and an intermediate rib fabric layer Patent

Sawko, Paul M.; inventor.Calamito, Dominic P.; inventor.and Jong, Anthony; inventor. 19 Sep. 1995 28 p Filed 1 Jul. 1993

Report No.(s): (NASA-CASE-ARC-11978-1; US-PATENT-CLASS-428-175; US-PATENT-CLASS-139/384R; US-PATENT-CLASS-244/148A; US-PATENT-CLASS- 428-184; US-PATENT-CLASS-428-220; US-PATENT-5, 451, 448;US-PATENT-APPL-SN-085387;US-PATENT-CLASS-428-229; NIPS-95-0614) Avail: US Patent and Trademark Office

Sewn, quilted ceramic blankets (advanced flexible reusable surface insulation, AFRSI) and integrally woven core insulation systems (tailorable advanced blanket insulation, TABI) were examined in a 170 decibel aeroacoustic environment under oscillating air loads. Preconditioning in a radiant heat source was done at both 2000 F and 2500 F before testing. A multilayer ceramic weave construction based on an angle interlock weave architecture is superior over all other thermal protection systems (TPS) examined. These configurations do not require a surface coating to enhance survivability. Single-ply TABI fabric surfaces using an insulated integrally woven core structure survive up to 2000 F without the use of a ceramic coating to toughen the surface to the aeroacoustic noise level. AFRSI blankets of the art require a ceramic coating in order to demonstrate comparable performance after exposure to a F radiant heat temperature.

Official Gazzette of the U.S. Patent and Trademark

Aeroacoustics; Ceramic Fibers; Ceramics; Fabrics; Heat Shielding; Multilayer Insulation; Thermal Insulation; Thermal Protection; Woven Composites;

N96-14666*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

Reliability analysis of single crystal NiAl turbine blades

Salem, Jonathan; Noebe, Ronald; Wheeler, Donald R.; Holland, Fred; Palko, Joseph; (Cleveland State Univ., OH.)Duffy, Stephen; (Cleveland State Univ., OH.)and Wright, P. Kennard; (General Electric Co., Cincinnati, OH.) 1 Jan. 1995 11 p

Report No.(s): (NASA-TM-111138; NAS 1.15:111138; NIPS-95-06099) Avail: CASI HC A03/MF A01

As part of a co-operative agreement with General Electric Aircraft Engines (GEAE), NASA LeRC is modifying and validating the Ceramic Analysis and Reliability Evaluation of Structures algorithm for use in design of components made of high strength NiAl based intermetallic materials. NiAl single crystal alloys are being actively investigated by GEAE as a replacement for Ni-based single crystal superalloys for use in high pressure turbine blades and vanes. The driving force for this research lies in the numerous property advantages offered by NiAl alloys over their superalloy counterparts. These include a reduction of density by as much as a third without significantly sacrificing strength, higher melting point, greater thermal conductivity, better oxidation resistance, and a better response to thermal barrier coatings. The current drawback to high strength NiAl single crystals is their limited ductility. Consequently, significant efforts including the work agreement with GEAE are underway to develop testing and design methodologies for these materials. The approach to validation and component analysis involves the following steps: determination of the statistical nature and source of fracture in a high strength, NiAl single crystal turbine blade material; measurement of the failure strength envelope of the material; coding of statistically based reliability models; verification of the code and model; and modeling of turbine blades and vanes for rig testing.

Author

Aircraft Engines; Algorithms; Ceramics; Ductility; Failure Analysis; Finite Element Method; Fracture Strength; Gas Turbine Engines; High Strength Alloys; Reliability Analysis; Turbine Blades; Weibull Density Functions;

N96-14807# Duquesne Univ., Pittsburgh, PA.

Development of stabilizing additives for super-critical jet fuel Final Report, 1 May 1993 - 30 Jun. 1995

Beaver, Bruce; 24 Jul. 1995 15 p

Contract(s)/Grant(s): (F49620-93-1-0224)

Report No.(s): (AD-A298024; AFOSR-95-0507TR) Avail: CASI HC A03/MF A01

In this proposal it is argued that the thermal stability of most jet fuels would be dramatically improved by the efficient removal of a fuel's dissolved oxygen (in flight). It is envisioned that a thermally activated reaction between the oxygen scavenging additive and dissolved oxygen will occur, in a controlled and directed manner, such that formation of insoluble thermal degradation products will be limited. To date our data has identified several potential additive candidates which meet our preliminary specifications. With continued funding suitable stabilizing additives for super-critical jet fuels will be developed.

DTIC

Additives; Jet Engine Fuels; Oxygen; Stabilizers (agents); Supercritical Flow; Thermal Stability;

N96-15625*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
Fracture analysis of stiffened panels under biaxial loading with widespread cracking
Newman, Jr., J. C.; 1 Oct. 1995 38 p
Contract(s)/Grant(s): (RTOP 538-02-10-01)
Report No.(s): (NASA-TM-110197; NAS 1.15:110197; NIPS-95-06402) Avail: CASI HC A03/MF A01

An elastic-plastic finite-element analysis with a critical crack-tip opening angle (CTOA) fracture criterion was used to model stable crack growth and fracture of 2024-T3 aluminum alloy (bare and clad) panels for several thicknesses. The panels had either single or multiple-site damage (MSD) cracks subjected to uniaxial or biaxial loading. Analyses were also conducted on cracked stiffened panels with single or MSD cracks. The critical CTOA value for each thickness was determined by matching the failure load on a middle-crack tension specimen. Comparisons were made between the critical angles determined from the finite-element analyses and those measured with photographic methods. Predicted load-against-crack extension and failure loads for panels under biaxial loading, panels with MSD cracks, and panels with various numbers of stiffeners were compared with test data whenever possible. The predicted results agreed well with the test data even for large-scale plastic deformations. The analyses were also able to predict stable tearing behavior of a large lead crack in the presence of MSD cracks. The analyses were then used to study the influence of stiffeners on residual strength in the presence of widespread fatigue cracking. Small MSD cracks were found to greatly reduce the residual strength for large lead cracks even for stiffened panels.
Author
Aluminum Alloys; Axial Loads; Crack Propagation; Crack Tips; Cracking (fracturing); Finite Element Method; Metal Fatigue; Panels;

12 ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

N96-14211# Technion Research and Development Foundation Ltd., Haifa (Israel).
Shock induced detonation on projectiles in hypersonic flows of detonable gas mixtures Final Report, 1 May 1994 - 31 Apr. 1995
Rom, Josef; 30 Jun. 1995 77 p
Contract(s)/Grant(s): (N68171-94-C-9065)
Report No.(s): (AD-A297325; R/D-7175-AN-01) Avail: CASI HC A05/MF A01

The following subjects were investigated: (1) CFD results on the External Propulsion Accelerator (EPA) projectile configurations; (2) an analytical study on the stability of hypersonic reacting flow at the stagnation region of a blunt body using dynamical system analysis; (3) the use of the EPA for scramjet combustion research; (4) the use of the EPA for hypersonic aerodynamic test facility; (5) analysis of the initiation of detonation on a hypervelocity projectile and it's maximum velocity in the EPA; and (6) preparations for testing at the Army Research Laboratory's ram accelerator facility at Aberdeen, MD. The CFD calculations on the projectile configurations indicated a well established external combustion zone and reasonably large thrust. Analysis using energy balance considerations indicated that the maximum projectile velocity in the EPA is about 6 times the detonation speed while that for the ram accelerator is about 1.3 times the detonation speed of the mixture. Therefore, the EPA is capable of accelerating missile-projectiles to beyond the escape velocity and can be considered also for single stage to orbit missions.
DTIC
Combustible Flow; Detonable Gas Mixtures; Detonation Waves; Gas Explosions; Hypersonic Flow; Hypervelocity Launchers; Hypervelocity Projectiles; Shock Wave Interaction;

N96-14280 Case Western Reserve Univ., Cleveland, OH.
Routes to chaos in rotor dynamics Ph.D. Thesis
Abu-Mahfouz, Issam Abdullah; 1993 367 p Avail: Univ. Microfilms Order No. DA9416187

The behavior of three fundamental nonlinear rotordynamical systems are investigated with particular attention on the routes to chaotic motion: (1) rotor-stator rub-impact interaction modeled by a Hertzian contact radial force and a Coulomb friction tangential force; (2) dynamically unstable hydrodynamic journal bearing; and (3) statically and dynamically unstable pivoted-pad journal bearings (PPJB). In each of these systems the dynamical disturbance is from rotor unbalance. A quite extensive numerical experimentation for a wide range of parameters yields results rich in subharmonic, quasiperiodic and chaotic motions. Orbital motions, phase-portraits for the pads in terms of their angular pitching velocity and amplitude, Poincare maps and bifurcation diagrams are used as qualitative descriptors to observe the evolution of chaos in the systems considered. Numerical evidence of different routes to and out of chaos are delineated and categorized. Feigenbaum type, period-doubling (period-halving), quasiperiodic with period locking, and sudden (crisis) sequences of bifurcation leading to and out of chaotic regions are produced. These rotor dynamical phenomena are potentially of considerable value as a diagnostic tool in assessing condition monitoring signals that are now routinely taken on modern rotating machinery. Although the systems considered are relatively simple and very important in rotor

dynamics, their chaotic behavior has not been investigated before. The present work presents new insights significant to understanding highly complicated nonlinear behaviors of rotor dynamics. This work also provides a strong motivation for further work on chaos content of rotor dynamical systems, particularly for higher order systems, i.e., multi-bearing flexible rotors.
Dissert. Abstr.
Chaos; Dynamic Stability; Journal Bearings; Nonlinear Systems; Rotary Stability; Rotor Dynamics; Rotors; Stators;

N96-14601*# Cleveland State Univ., OH.
Design protocols and analytical strategies that incorporate structural reliability models Final Report, 1 Sep. 1993 - 31 Aug. 1995
Duffy, Stephen F.; 31 Aug. 1995 14 p
Contract(s)/Grant(s): (NCC3-310)
Report No.(s): (NASA-CR-199722; NAS 1.26:199722; NIPS-95-06080) Avail: CASI HC A03/MF A01

In spite of great improvements in accuracy through the use of computers, design methods, which can be equally critical in establishing the commercial success of a material, have been treated as afterthoughts. Early investment in design and development technologies can easily reduce manufacturing costs later in the product cycle. To avoid lengthy product development times for ceramic composites, funding agencies for materials research must commit resources to support design and development technologies early in the material life cycle. These technologies need not focus on designing the material, rather, the technology must focus on designing with the material, i. e., developing methods to design components fabricated from the new material. Thus a basic tenet that motivated this research effort is that a persistent need exists for improvements in the analysis of components fabricated from CMC material systems. From an aerospace design engineer's perspective the new generation of ceramic composites offers a significant potential for raising the thrust/weight ratio and reducing NOx emissions of gas turbine engines. Continuous ceramic fiber composites exhibit an increase in work of fracture, which allows for 'graceful' rather than catastrophic failure. When loaded in the fiber direction, these composites retain substantial strength capacity beyond the initiation of transverse matrix cracking despite the fact that neither of its constituents would exhibit such behavior if tested alone. As additional load is applied beyond first matrix cracking, the matrix tends to break in a series of cracks bridged by the ceramic fibers. Thus any additional load is born increasingly by the fibers until the ultimate strength of the composite is reached. Establishing design protocols that enable the engineer to analyze and predict this type of behavior in ceramic composites was the general goal of this project.
Derived from text
Ceramic Fibers; Ceramic Matrix Composites; Design Analysis; Failure Analysis; Fiber Composites; Fracture Strength; Gas Turbine Engines; Reliability Analysis; Service Life; Structural Reliability; Turbine Blades;

N96-14761 Centre National de la Recherche Scientifique, Marseilles (France).
Study of the radiating surfaces of vibrating structures: Application to radiation minimization Final Report [Etude des surfaces rayonnantes des structures vibrantes: Application a la minimisation du rayonnement]
Dahan, F.; 31 Jan. 1994 66 p In FRENCH Prepared in cooperation with Direction des Recherches, Etudes et Techniques
Report No.(s): (PB95-258067) Avail: Issuing Activity (National Technical Information Service (NTIS))

In the hope of using radiating surfaces for active structural acoustic control, we identified the problems's sensitivity to modal restructuring, and thus the fragility of an approach based on analyzing physical phenomena before control. Switching to a global approach yielded information on control that could be used to limit vibration applications. It also led us to consider the position of the vibration sensors, to determine optimal placement. What we actually learned was the optimal number of sensors as a function of the number of actuators, and which position has an easily accessible physical meaning, namely the vibration nodes of the structural field that is created when control measures are no longer in effect.
NTIS
Active Control; Smart Structures; Structural Stability; Structural Vibration; Vibration Damping; Vibration Isolators; Vibration Mode;

N96-14790# Los Alamos National Lab., NM.
The Russian-American high magnetic field collaboration
Fowler, C. M.; Christian, J. M.; and Freeman, B. L.; 1995 7 p Presented at the 10th Institute of Electrical and Electronics Engineers (IEEE) Pulsed Power Conference, Albuquerque, NM, 10-13 Jul. 1995
Contract(s)/Grant(s): (W-7405-ENG-36)
Report No.(s): (DE95-015270; LA-UR-95-1921; CONF-950750-25) Avail: CASI HC A02/MF A01

We report here on a joint experimental shot series with teams from Russia and the United States. The program was based largely upon the MC-1 generator, a high magnetic field explosive flux compressor, developed by the Pavlovskii group at Arzamas-16. The series was of historical interest in that it was carried out in a Los Alamos security area, the first time for such a collaboration. We discuss a number of technical issues involved in matching Russian hardware with Los Alamos explosives, initiation systems and the seed field energy source, as well as comparison of field measuring diagnostics finished by the two teams. We conclude with a dis-

cussion of an investigation of the high temperature superconductor YBa2Cu3O7 (YBCO), employing these generators. The low temperature critical magnetic field of this material was found to be 340 +/- 40 T, as determined from a 94 GHz microwave interferometer developed for this purpose.
DOE
Chemical Explosions; Magnetic Fields; Pulse Generators; Ybco Superconductors;

N96-14817# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
Automatic layout of integrated-optics time-of-flight circuits Ph.D. Thesis
Kennett-Fogg, Ruth D.; 19 Apr. 1995 146 p
Report No.(s): (AD-A298363; AFIT/CI/CIA-95-051) Avail: CASI HC A07/MF A02

This work describes the architecture and algorithms used in the computer aided design tool developed for the automatic layout of integrated optic, time of flight circuit designs. This is similar to the layout of electronic VLSI circuits, where total wire length and chip area minimization are the major goals. Likewise, total wire length and chip area minimization are also the goals in the layout of time of flight circuits. However, there are two major differences between the layout of time of flight circuits and VLSI circuits. First, the interconnection lengths of time of flight designs are exactly specified in order to achieve the necessary delays for signal synchronization. Secondly, the switching elements are 120 times longer than they are wide. This highly astigmatic aspect ratio causes severe constraints on how and where the switches are placed. The assumed development of integrated corner turning mirrors allows the use of a parallel, row based device placement architecture and a rectangular, fixed grid track system for the connecting paths. The layout process proceeds in two steps. The first step involves the use of a partial circuit graph representation to place the elements in rows, oriented in the direction of the signal flow. After iterative improvement of the placement, the second step proceeds with the routing of the connecting paths. The main problem in the automatic layout of time of flight circuits is achieving the correct path lengths without overlapping previously routed paths. This problem is solved by taking advantage of a certain degree of variability present in each path, allowing the use of simple heuristics to circumvent previously routed paths.
DTIC
Algorithms; Architecture (computers); Chips (electronics); Computer Aided Design; Heuristic Methods; Integrated Circuits; Integrated Optics; Optical Switching; Switching Circuits;

N96-15100# Massachusetts Inst. of Tech., Lexington, MA.
GPS antenna multipath rejection performance
Dinius, A. M.; 7 Aug. 1995 44 p Limited Reproducibility: Document partially illegible
Contract(s)/Grant(s): (DTFA01-93-Z-02012; F19628- 95-C-0002)
Report No.(s): (AD-A298107; ATC-238) Avail: CASI HC A03/MF A01

A GPS antenna multipath rejection performance evaluation was conducted. Ground reference station antennas and aviation patches were tested for their ability to reject a multipath signal. Different types of ground plane structures were used such as choke rings, ground planes, and mock sections of fuselage. Frequencies transmitted were L1 (1575 MHz), L2 (1227 MHz), and the median GLONASS frequency (1609 MHz). Receive amplitude and phase were measured on each antenna. Subsequently, these data were converted to absolute gain for a right hand and left hand circularly polarized signal as a function of satellite elevation angle. Two types of multipath signals were considered: ground bounce multipath and building or structure bounce multipath. Ground bounce multipath typically occurs at low satellite elevation angles while structure bounce multipath can occur at any satellite elevation angle. Separate analysis methods were used to assess an antenna's ability to reject either type of multipath. This report describes the data collection methods, data reduction and analysis, and the results.
DTIC
Aircraft Antennas; Data Acquisition; Data Reduction; Global Positioning System; Multipath Transmission; Performance Tests; Radio Navigation; Radio Signals;

N96-15199*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
Convective heat transfer from castings of ice roughened surfaces in horizontal flight
Dukhan, Nihad; (Toledo Univ., OH.)Vanfossen, Jr., G. James; Masiulaniec, K. Cyril; (Toledo Univ., OH.)and Dewitt, Kenneth J.; (Toledo Univ., OH.) 1 Nov. 1995 24 p Presented at the International Icing Symposium 1995, Montreal, Canada, United States, 18-21 Sep. 1995; sponsored by AHS and SAE
Contract(s)/Grant(s): (NAG3-72; RTOP 505-68-10)
Report No.(s): (NASA-TM-107109; NAS 1.15:107109; E-10010; NIPS-95-06275) Avail: CASI HC A03/MF A01

A technique was developed to cast frozen ice shapes that had been grown on a metal surface. This technique was applied to a series of ice shapes that were grown in the NASA Lewis Icing Research Tunnel on flat plates. Eight different types of ice growths, characterizing different types of roughness, were obtained from these plates, from which aluminum castings were made. Test strips taken from these castings were outfitted with heat flux gages, such that when placed in a dry wind tunnel, they could be used to experimentally map out the convective heat transfer coefficient in the direction of flow from the roughened surfaces. The effects on the heat

transfer coefficient for parallel flow, which simulates horizontal flight, were studied. The results of this investigation can be used to help size heaters for wings, helicopter rotor blades, jet engine intakes, etc., or de-icing for anti-icing applications where the flow is parallel to the iced surface.
Author
Aircraft Safety; Convective Heat Transfer; Deicing; Heat Transfer Coefficients; Horizontal Flight; Ice Formation; Ice Prevention; Metal Surfaces; Parallel Flow; Surface Roughness; Wind Tunnel Tests;

N96-15342*# General Electric Co., Schenectady, NY. Engineering Mechanics Lab.
Probabilistic analysis of large-scale composite structures using the IPACS code
Lemonds, Jeffrey; and Kumar, Virendra; 1 Oct. 1995 30 p
Contract(s)/Grant(s): (NAS3-26617; RTOP 505-63-5B)
Report No.(s): (NASA-CR-198409; NAS 1.26:198409; E-9948; NIPS-95-06269) Avail: CASI HC A03/MF A01

An investigation was performed to ascertain the feasibility of using IPACS (Integrated Probabilistic Assessment of Composite Structures) for probabilistic analysis of a composite fan blade, the development of which is being pursued by various industries for the next generation of aircraft engines. A model representative of the class of fan blades used in the GE90 engine has been chosen as the structural component to be analyzed with IPACS. In this study, typical uncertainties are assumed in the level, and structural responses for ply stresses and frequencies are evaluated in the form of cumulative probability density functions. Because of the geometric complexity of the blade, the number of plies varies from several hundred at the root to about a hundred at the tip. This represents a extremely complex composites application for the IPACS code. A sensitivity study with respect to various random variables is also performed.
Author
Applications Programs (computers); Composite Structures; Dynamic Response; Dynamic Structural Analysis; Engine Parts; Fan Blades;

N96-15350*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
An edge-based solution-adaptive method applied to the AIRPLANE code
Biswas, Rupak; Thomas, Scott D.; (Sterling Software, Inc., Palo Alto, CA.)and Cliff, Susan E.; (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) 1 Nov. 1995 13 p Presented at the AIAA 34th Aerospace Sciences Meeting and Exhibit, Reno, NV, United States, 15-18 Jan. 1996
Contract(s)/Grant(s): (NAS2-13721)
Report No.(s): (NASA-CR-199754; NAS 1.26:199754; RIACS-TR-95-22; AIAA PAPER 96-0553; NIPS-95-06387) Avail: CASI HC A03/MF A01

Computational methods to solve large-scale realistic problems in fluid flow can be made more efficient and cost effective by using them in conjunction with dynamic mesh adaption procedures that perform simultaneous coarsening and refinement to capture flow features of interest. This work couples the tetrahedral mesh adaption scheme, 3D_TAG, with the AIRPLANE code to solve complete aircraft configuration problems in transonic and supersonic flow regimes. Results indicate that the near-field sonic boom pressure signature of a cone-cylinder is improved, the oblique and normal shocks are better resolved on a transonic wing, and the bow shock ahead of an unstarted inlet is better defined.
Author
Aircraft Configurations; Flow Distribution; Grid Generation (mathematics); Near Fields; Pressure Distribution; Shock Waves; Sonic Booms; Supersonic Flow; Transonic Flow; Unstructured Grids (mathematics);

N96-15393# Donmar Ltd., Newport Beach, CA.
Characteristics of optical fire detector false alarm sources and qualification test procedures to prove immunity, phase 2, volume 3: Appendix 2 Final Report, Apr. 1991 - Oct. 1992
Goedeke, A. D.; and Gross, H. G.; May 1995 87 p
Contract(s)/Grant(s): (F08635-91-C-0129)
Report No.(s): (AD-A297351; WL-TR-93-3522-VOL-3) Avail: CASI HC A05/MF A01

This study identified possible sources of UV, IR and visible radiations that may cause an optical fire detector to false alarm and/or affect its fire detection performance. The spectral irradiances of JP-4 pan fires and a multitude of lamps, hot bodies, and other of radiation stimuli that an optical detector may be exposed to in any type of aircraft shelter, hanger, facility, or ground location, were determined. Knowing the spectral irradiances of the required fire size and distance to be detected, it was then possible to determine at what distances would the potential false alarm source have to be to equal or exceed the fire's spectral irradiances in the 185nm - 250nm and 4.4lm bands. Considering the possible distance from detector to source, candidate false alarm sources were selected for detector immunity testing. Qualification test procedures were developed and tested. It was concluded that there are many possible false alarm sources and, if located too close to a detector, and the stimuli are modulated, most optical fire detectors would alarm.
DTIC
False Alarms; Fire Prevention; Fires; Infrared Radiation; Light (visible Radiation); Optical Measuring Instruments; Performance Tests; Ultraviolet Radiation; Warning Systems;

N96-15464 Department of the Navy, Washington, DC.
Multistage variable area throttle valve Patent

Shiffler, Mark E.; inventor (to Navy)and Morris, Joseph H.; inventor (to Navy) 16 May 1995 9 p Filed 27 Jun. 1994
Report No.(s): (AD-D017569; US-PATENT-5,415,202; US-PATENT-APPL-SN-266062; US-PATENT-CLASS-137- 625)
Avail: US Patent and Trademark Office

A throttle or fluid control valve uses at least one compressible multi-wave washer as a fluid control element. The apertures formed by the multi-wave washer are short and of low aspect ratio when the valve is fully open to limit pressure drop across the valve, thus substantially preventing cavitation and flow related noise to high flow velocities. As the valve is closed, the aspect ratio of the apertures increases but surfaces of the apertures remain angled to each other to provide noise cancellation and damping. Several multi-wave washers spaced by sliders are preferably used to further limit pressure drop in any stage and to form a serpentine path in the general direction of flow to provide further noise cancellation and damping. The sliders also enhance the self purging action of the valve structure. A closure structure is also provided for assuring full closure of the valve.
DTIC
Apertures; Control Equipment; Control Valves; Washers (spacers);

N96-15517# Lawrence Livermore National Lab., Livermore, CA.
Modeling release behavior in shocked tantalum
Steinberg, D. J.; Aug. 1995 6 p Presented at the American Physical Society Biennial Conference on Shock Compression of Condensed Matter, Seattle, WA, 13-18 Aug. 1995
Contract(s)/Grant(s): (W-7405-ENG-48)
Report No.(s): (DE95-017260; UCRL-JC-121814; CONF-950846-36) Avail: CASI HC A02/MF A01

Using Johnson's anelastic release model for metals (3,4), hydrocode simulation of four Ta plate-impact experiments were performed. These calculations agree well with the data as long as the complete non-linear version of the model is used and the yield surface is itself made asymmetric, i.e., different on loading and unloading. From the parameters in the model it is possible to determine the drag coefficient, mobile dislocation density, and characteristic length of a dislocation, and to obtain reasonable values.
DOE
Aerodynamic Coefficients; Aerodynamic Drag; Anelasticity; Metals; Tantalum;

N96-15562*# Centre National de la Recherche Scientifique, Orleans (France). Lab. de Combustion et Systemes Reactifs.
High pressure droplet burning experiments in reduced gravity c29
Chauveau, Christian; and Goekalp, Iskender; In NASA. Lewis Research Center, The 3rd International Microgravity Combustion Workshop Aug. 1995 p 71-76 Sponsored by ESA Microgravity Program Original contains color illustrations (For primary document see N96-15552 03-29) Avail: CASI HC A02/MF A04; 8 functional color pages

A parametric investigation of single droplet gasification regimes is helpful in providing the necessary physical ideas for sub-grid models used in spray combustion numerical prediction codes. A research program has been initiated at the LCSR to explore the vaporization regimes of single and interacting hydrocarbon and liquid oxygen droplets under high pressure conditions. This paper summarizes the status of the LCSR program on the high pressure burning of single fuel droplets; recent results obtained under normal and reduced gravity conditions with suspended droplets are presented. In the work described here, parabolic flights of the CNES Caravelle is used to create a reduced gravity environment of the order of 10(exp -2) g(sub O). For all the droplet burning experiments reported here, the suspended droplet initial diameters are scattered around 1.5 mm; and the ambient air temperature is 300 K. The ambient pressure is varied between 0.1 MPa and 12 MPa. Four fuels are investigated: methanol (Pc = 7.9 MPa), n-heptane (Pc = 2.74 MPa), n-hexane (Pc = 3.01 MPa) and n-octane (Pc = 2.48 MPa).
Derived from text
Drops (liquids); Fuel Combustion; Gasification; Heptanes; High Pressure; Hydrocarbons; Liquid Oxygen; Methyl Alcohol; Microgravity; Octanes;

N96-15641*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
Predictions of thermal buckling strengths of hypersonic aircraft sandwich panels using minimum potential energy and finite element methods
Ko, William L.; 1 May 1995 56 p
Contract(s)/Grant(s): (RTOP 505-70-63)
Report No.(s): (NASA-TM-4643; NAS 1.15:4643; H-2009; NIPS-95-06451) Avail: CASI HC A04/MF A01

Thermal buckling characteristics of hypersonic aircraft sandwich panels of various aspect ratios were investigated. The panel is fastened at its four edges to the substructures under four different edge conditions and is subjected to uniform temperature loading. Minimum potential energy theory and finite element methods were used to calculate the panel buckling temperatures. The two methods gave fairly close buckling temperatures. However, the finite element method gave slightly lower buckling temperatures than those given by the minimum potential energy theory. The reasons for this slight discrepancy in eigensolutions are discussed in detail. In addition, the effect of eigenshifting on the eigenvalue convergence rate is discussed.
Author
Aerodynamic Heating; Aerodynamic Loads; Aircraft Design; Applications Programs (computers); Aspect Ratio; Computer Aided Design; Critical Temperature; Energy

Methods; Finite Element Method; Hypersonic Aircraft; Rayleigh-ritz Method; Rectangular Panels; Sandwich Structures; Thermal Buckling;

N96-15702# Oak Ridge National Lab., TN.
Materials/manufacturing support element for the Advanced Turbine Systems Program
Karnitz, M. A.; Hoffman, E. E.; and Parks, W. P.; 1994 8p
Contract(s)/Grant(s): (DE-AC05-84OR-21400)
Report No.(s): (DE95-014043; DOE/OR-21400/T476)
Avail: CASI HC A02/MF A01

In 1993, DOE initiated a program to develop advanced gas turbines for power generation in utility and industrial applications. A materials/manufacturing plan was developed in several stages with input from gas turbine manufacturers, materials suppliers, universities, and government laboratories. This plan was developed by a small advanced materials and turbine technology team over a 6-month period. The technology plan calls for initiation of several high priority projects in FY 1995. The technical program for the materials/manufacturing element focuses on generic materials issues, components, and manufacturing processes. Categories include coatings and process development, turbine airfoil development, ceramics adaptation, directional solidification and single crystal airfoils manufacturing technology, materials characterization, catalytic combustor materials, and technology information exchange.
DOE
Design Analysis; Gas Turbines; Manufacturing; Mechanical Properties;

N96-15749*# Old Dominion Univ., Norfolk, VA.
Flow simulations about steady-complex and unsteady moving configurations using structured-overlapped and unstructured grids
Newman, III, James C.; 1 Jan. 1995 2 p
Report No.(s): (NASA-CR-199781; NAS 1.26:199781; NIPS-95-06448) Avail: CASI HC A01/MF A01; Abstract Only

The limiting factor in simulating flows past realistic configurations of interest has been the discretization of the physical domain on which the governing equations of fluid flow may be solved. In an attempt to circumvent this problem, many Computational Fluid Dynamic (CFD) methodologies that are based on different grid generation and domain decomposition techniques have been developed. However, due to the costs involved and expertise required, very few comparative studies between these methods have been performed. In the present work, the two CFD methodologies which show the most promise for treating complex three-dimensional configurations as well as unsteady moving boundary problems are evaluated. These are namely the structured-overlapped and the unstructured grid schemes. Both methods use a cell centered, finite volume, upwind approach. The structured-overlapped algorithm uses an approximately factored, alternating direction implicit scheme to perform the time integration, whereas, the unstructured algorithm uses an explicit Runge-Kutta method. To examine the accuracy, efficiency, and limitations of each scheme, they are applied to the same steady complex multicomponent configurations and unsteady moving boundary problems. The steady complex cases consist of computing the subsonic flow about a two-dimensional high-lift multielement airfoil and the transonic flow about a three-dimensional wing/pylon/finned store assembly. The unsteady moving boundary problems are a forced pitching oscillation of an airfoil in a transonic freestream and a two-dimensional, subsonic airfoil/store separation sequence. Accuracy was accessed through the comparison of computed and experimentally measured pressure coefficient data on several of the wing/pylon/finned store assembly's components and at numerous angles-of-attack for the pitching airfoil. From this study, it was found that both the structured-overlapped and the unstructured grid schemes yielded flow solutions of comparable accuracy for these simulations. This study also indicated that, overall, the structured-overlapped scheme was slightly more CPU efficient than the unstructured approach. Author
Airfoils; Alternating Direction Implicit Methods; Boundary Value Problems; Computational Fluid Dynamics; External Store Separation; Finite Volume Method; Finned Bodies; Pylons; Runge-kutta Method; Structured Grids (mathematics); Three Dimensional Flow; Three Dimensional Models; Unstructured Grids (mathematics); Upwind Schemes (mathematics);

N96-15750*# Old Dominion Univ., Norfolk, VA. Dept. of Aerospace Engineering.
Three-dimensional unstructured method for flows past bodies in 6-DOF relative motion
Singh, K. P.; and Baysal, Oktay; 8 Sep. 1995 3 p Repr. from Proceedings of 6th International Symposium on Computational Fluid Dynamics: A Collection of Technical Papers, Volume 3 Presented at the 6th International Symposium on Computational Fluid Dynamics: A Collection of Technis, 4-8 Sep. 1996; sponsored by Japanese Society of Computational Fluid Dynamics Submitted for publication in AIAA Journal
Report No.(s): (NASA-CR-199780; NAS 1.26:199780; NIPS-95-06449) Avail: CASI HC A01/MF A01; Abstract Only

A three dimensional, unstructured-mesh methodology was developed to simulate unsteady flows past bodies in relative motion, where the trajectory was determined from the instantaneous aerodynamics. The method coupled the equations of fluid flow and those of rigid-body dynamics, and captured the time-dependent interference between stationary and moving bound-

aries. The unsteady, compressible Euler equations were solved on dynamic, unstructured meshes by an explicit, finite-volume, upwind method. The grid adaptation was performed within a window placed around the moving body. The Euler equations of dynamics were solved by a Runge-Kutta integration scheme. The flow solver and the adaptation scheme were validated by simulating the transonic, unsteady flow around a wing undergoing a forced, periodic pitching motion, then comparing the results with the experimental data. To validate the trajectory code, the six-degrees-of-freedom (DOF) motion of a store separating from a wing was computed using the experimentally determined force and moment fields, then comparing with an independently generated trajectory. Finally, the overall methodology was demonstrated by simulating the unsteady flowfield and the trajectory of a store dropped from a wing. The methodology, its computational cost notwithstanding, has proven to be accurate, automated, easy for dynamic gridding, and relatively efficient for the required man-hours.
Author
Boundary Value Problems; Computational Fluid Dynamics; Degrees of Freedom; Euler Equations of Motion; External Store Separation; Flow Equations; Rigid Wings; Runge-kutta Method; Three Dimensional Flow; Time Dependence; Unstructured Grids (mathematics);

N96-15877# Los Alamos National Lab., NM.
Results of Russian/US high performance DEMG experiment
Buyko, A. M.; Bidylo, N. P.; and Chernyshev, V. K.; 1995 15 p Presented at the 10th Institute of Electrical and Electronics Engineers (IEEE) Pulsed Power Conference, Albuquerque, NM, 10-13 Jul. 1995
Contract(s)/Grant(s): (W-7405-ENG-36)
Report No.(s): (DE95-016776; LA-UR-95-2367; CONF-950750-14) Avail: CASI HC A03/MF A01

In November 1992, the All Russian Scientific Research Institute of Experimental Physics (VNIIEF), Arzamas-16, Russia and the Los Alamos National Laboratory, Los Alamos NM, USA embarked on a historic effort to conduct a joint explosive pulse-power experiment. With the concurrence of the Ministry of Atomic Energy (Russia) and the Department of Energy (USA), the two laboratories entered into a Laboratory-to-Laboratory collaboration in the areas of very high energy pulse power and ultrahigh magnetic fields in order to explore problems of mutual scientific interest. The first experiment was an explosively powered, fast, high-current pulse-power experiment. The experiment employed a flux compressor, inductive store, and opening switch to demonstrate the feasibility of supplying many megajoules of electrical energy on microsecond time scales, to high energy density physics experiments. The experiment was successfully conducted in Arzamas-16 on September 22, 1993.
DOE
Chemical Explosions; Detonation; Equipment Specifications; Nuclear Electric Power Generation;

N96-16028# Solar Turbines, Inc. San Diego, CA.
Ceramic stationary gas turbine development Technical Progress Report, 1 Apr. 1993 - 31 Oct. 1994
Dec. 1994 120 p
Contract(s)/Grant(s): (DE-AC02-92CE-40960)
Report No.(s): (DE95-017792; DOE/CE-40960/T1) Avail: CASI HC A06/MF A02

This report summarizes work performed by Solar Technologies Inc. and its subcontractors, during the period April 1, 1993 through October 31, 1994 under Phase 2 of the DOE Ceramic Stationary Gas Turbine Development program. The objective of the program is to improve the performance of stationary gas turbines in cogeneration through the implementation of selected ceramic components.
DOE
Aircraft Construction Materials; Ceramics; Gas Turbine Engines; Gas Turbines; Turbine Blades;

N96-16042*# North Carolina State Univ., Raleigh, NC. Dept. of Mechanical Engineering.
User's manual for the one-dimensional hypersonic experimental aero-thermodynamic (1DHEAT) data reduction code
Hollis, Brian R.; Aug. 1995 73 p
Contract(s)/Grant(s): (NAGW-1331; NAG1-1663; RTOP 242-20-08-02)
Report No.(s): (NASA-CR-4691; NAS 1.26:4691) Avail: CASI HC A04/MF A01

A FORTRAN computer code for the reduction and analysis of experimental heat transfer data has been developed. This code can be utilized to determine heat transfer rates from surface temperature measurements made using either thin-film resistance gages or coaxial surface thermocouples. Both an analytical and a numerical finite-volume heat transfer model are implemented in this code. The analytical solution is based on a one-dimensional, semi-infinite wall thickness model with the approximation of constant substrate thermal properties, which is empirically corrected for the effects of variable thermal properties. The finite-volume solution is based on a one-dimensional, implicit discretization. The finite-volume model directly incorporates the effects of variable substrate thermal properties and does not require the semi-finite wall thickness approximation used in the analytical model. This model also includes the option of a multiple-layer substrate. Fast, accurate results can be obtained using either method. This code has been used to reduce several sets

of aerodynamic heating data, of which samples are included in this report.
Author
Aerothermodynamics; Data Reduction; Heat Transfer; Hypersonics; Mathematical Models; Temperature Measurement; User Manuals (computer Programs);

13 GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

N96-14557# Hughes STX, Inc., Lexington, MA.
Radar studies of aviation hazards
Harris, F. I.; Smalley, David J.; and Tung, Shu-Lin; 31 May 1995 28 p
Contract(s)/Grant(s): (F19628-93-C-0054)
Report No.(s): (AD-A297388; STX-SR-2; PL-TR-95-2079)
Avail: CASI HC A03/MF A01

Hughes STX is developing algorithms/techniques that are targeted for use with the WSR-88D weather radars. Phenomena being addressed are precursors to severe weather, precursors to lightning, and the monitoring of potentially hazardous weather associated with baroclinic front situations. Progress made during the past year in each of the algorithms is outlined.
DTIC
Aerospace Safety; Aircraft Hazards; Doppler Radar; Flight Hazards; Meteorological Radar;

14 LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and planetary biology.

No abstracts in this category.

15 MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

N96-14111# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Graduate School of Engineering.
Optimal mixed-norm control synthesis for discrete-time linear systems Ph.D. Thesis
Jacques, David R.; Jun. 1995 233 p
Report No.(s): (AD-A297442; AFIT/DS/ENY/95-02)
Avail: CASI HC A11/MF A03

A mixed-norm approach to control synthesis for discrete time linear systems is developed. Specifically, the problem of minimizing the H(sub 2) norm of a transfer function subject to a combination of l(sub 1) and/or H(sub infinity) norm constraints on dissimilar but related transfer functions is considered. The uniqueness of the optimal solution is shown, and numerical methods for approximating the optimal solution to within arbitrary accuracy are developed. These methods generally result in high order compensators which can not be implemented in most practical applications. In response to this, a numerical method is developed which solves for suboptimal solutions of a fixed, specifiable order. The method is packaged as a toolbox for the popular MATLAB software program. Several examples are developed which demonstrate potential applications for the mixed-norm method.
DTIC
Control Systems Design; Control Theory; Feedback Control; Linear Systems; Nonlinear Programming; Optimal Control;

N96-14899*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
Proceedings of the 1993 Conference on Intelligent Computer-Aided Training and Virtual Environment Technology
Hyde, Patricia R.; (Houston Univ., TX.)and Loftin, R. Bowen; (Houston Univ., TX.) 7 May 1993 220 p Conference held in Houston, TX, 5-7 May 1993; sponsored by Army Training and Doctrine Command, and Houston Univ.-Clear Lake
Report No.(s): (NASA-TM-111098-VOL-2; NAS 1.15: 111098-VOL-2) Avail: CASI HC A10/MF A03

The volume 2 proceedings from the 1993 Conference on Intelligent Computer-Aided Training and Virtual Environment Technology are presented. Topics discussed include intelligent computer assisted training (ICAT) systems architectures, ICAT educational and medical applications, virtual environment (VE) training and assessment, human factors engineering and VE, ICAT theory and natural language processing, ICAT military applications, VE engineering applications, ICAT knowledge acquisition processes and applications, and ICAT aerospace applications. For individual titles, see N96-14900 through N96-14918.
Artificial Intelligence; Computer Aided Design; Computer Assisted Instruction; Computer Techniques; Conferences; Environment Simulation; Human Factors Engineering; Human-computer Interface; Knowledge Based Systems; Man Machine Systems; Software Engineering; Systems Engineering; Virtual Reality;

N96-14905*# Army Research Inst., Alexandria, VA.
Virtual egocenters as a function of display geometric field of view and eye station point c61

Psotka, Joseph; In NASA. Johnson Space Center, Proceedings of the 1993 Conference on Intelligent Computer-Aided Training and Virtual Environment Technology 7 May 1993 p 277-284 (For primary document see N96-14899 03-61) Avail: CASI HC A02/MF A03

The accurate location of one's virtual egocenter in a geometric space is of critical importance for immersion technologies. This experiment was conducted to investigate the role of field of view (FOV) and observer station points in the perception of the location of one's egocenter (the personal viewpoint) in virtual space. Rivalrous cues to the accurate location of one's egocenter may be one factor involved in simulator sickness. Fourteen subjects viewed an animated 3D model, of the room in which they sat, binocularly, from Eye Station Points (ESP) of either 300 or 800 millimeters. The display was on a 190 by 245 mm monitor, at a resolution of 320 by 200 pixels with 256 colors. They saw four models of the room designed with four geometric field of view (FOVg) conditions of 18, 48, 86, and 140 degrees. They drew the apparent paths of the camera in the room on a bitmap of the room as seen from infinity above. Large differences in the paths of the camera were seen as a function of both FOVg and ESP. Ten of the subjects were then asked to find the position for each display that minimized camera motion. The results fit well with predictions from an equation that took the ratio of human FOV (roughly 180 degrees) to FOVg times the Geometric Eye Point (GEP) of the imager: Zero Station Point = (180/FOVg)*GEP

Author

Eye (anatomy); Field of View; Geometric Accuracy; Human Factors Engineering; Identifying; Space Perception; Technological Forecasting; Virtual Reality; Visual Discrimination;

N96-14913*# Computer Sciences Corp., Moffett Field, CA. Numerical Aerodynamic Simulation Systems Div.

The virtual windtunnel: Visualizing modern CFD datasets with a virtual environment c61

Bryson, Steve; In NASA. Johnson Space Center, Proceedings of the 1993 Conference on Intelligent Computer-Aided Training and Virtual Environment Technology 7 May 1993 p 390-395 (For primary document see N96-14899 03-61) Avail: CASI HC A02/MF A03

This paper describes work in progress on a virtual environment designed for the visualization of pre-computed fluid flows. The overall problems involved in the visualization of fluid flow are summarized, including computational, data management, and interface issues. Requirements for a flow visualization are summarized. Many aspects of the implementation of the virtual windtunnel were uniquely determined by these requirements. The user interface is described in detail.

Author

Computational Fluid Dynamics; Computer Aided Design; Computer Graphics; Environment Simulation; Flow Visualization; Fluid Flow; Training Simulators; Virtual Reality; Wind Tunnels;

N96-14990*# Galaxy Scientific Corp., Atlanta, GA.

Integrated Intelligent training and job aiding for combustion turbine engines c61

McKeithan, Jr., Clifford M.; and Quentin, George H.; (Electric Power Research Inst., Palo Alto, CA.) In NASA. Johnson Space Center, Proceedings of the 1993 Conference on Intelligent Computer-Aided Training and Virtual Environment Technology, Volume 1 7 May 1993 p 153-160 (For primary document see N96-14974 03-61) Avail: CASI HC A02/MF A02

This paper describes an ongoing program to augment such an expert system gas turbine startup advisor, known as the EPRI SA VANT System, by including an intelligent training package. It will give a brief background on the SA VANT development and an overview of its evolution into a full-blown Gas Turbine Information System (GTIS) for rapid access of on-line documentation, diagnostics, and training. In particular, the paper will address: (1) the conversion of the knowledge base used by the SA VANT startup advisor so that it can be used for both training and job aiding; and (2) the hypertext-oriented user manuals being incorporated into the system for rapidly accessing on-line documentation at the job site.

Derived from text

Computer Assisted Instruction; Expert Systems; Human-computer Interface; Information Systems; Turbine Engines;

N96-15194*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

Aerospace applications of integer and combinatorial optimization

Padula, S. L.; and Kincaid, R. K.; (College of William and Mary, Williamsburg, VA.) 1 Oct. 1995 20 p Presented at the 1995 SIAM Annual Meeting, Charlotte, NC, United States, 23-26 Oct. 1995

Contract(s)/Grant(s): (RTOP 505-63-36-06)

Report No.(s): (NASA-TM-110210; NAS 1.15:110210; NIPS-95-06260) Avail: CASI HC A03/MF A01

Research supported by NASA Langley Research Center includes many applications of aerospace design optimization and is conducted by teams of applied mathematicians and aerospace engineers. This paper investigates the benefits from this combined expertise in solving combinatorial optimization problems. Applications range from the design of large space antennas to interior noise control. A typical problem, for example, seeks the optimal locations for vibration-damping devices on a large space structure and is expressed

as a mixed/integer linear programming problem with more than 1500 design variables.
Author
Aerospace Engineering; Aircraft Design; Combinatorial Analysis; Design Analysis; Multidisciplinary Design Optimization; Spacecraft Design;

N96-15202*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
The transition of a real-time single-rotor helicopter simulation program to a supercomputer
Martinez, Debbie; 1 Oct. 1995 107 p
Contract(s)/Grant(s): (RTOP 505-90-53-02)
Report No.(s): (NASA-TM-110166; NAS 1.15:110166; NIPS-95-06375) Avail: CASI HC A06/MF A02

This report presents the conversion effort and results of a real-time flight simulation application transition to a CONVEX supercomputer. Enclosed is a detailed description of the conversion process and a brief description of the Langley Research Center's (LaRC) flight simulation application program structure. Currently, this simulation program may be configured to represent Sikorsky S-61 helicopter (a five-blade, single-rotor, commercial passenger-type helicopter) or an Army Cobra helicopter (either the AH-1 G or AH-1 S model). This report refers to the Sikorsky S-61 simulation program since it is the most frequently used configuration.
Author
Applications Programs (computers); Computerized Simulation; Flight Simulation; Real Time Operation; S-61 Helicopter; Supercomputers;

N96-15261# Software Productivity Consortium, Herndon, VA.
Investments in avionics and missiles software and software technology workshop report. Version 01.00.05 Final Report
Aug. 1995 444 p
Contract(s)/Grant(s): (MDA972-92-J-1018)
Report No.(s): (AD-A298330; SPC-95068-CMC) Avail: CASI HC A19/MF A04

This report contains the results of the Investments in Avionics and Missiles Software and Software Technology Workshop held on May 31 and June 1, 1995 at the Software Productivity Consortium. The workshop convened a group of government, industry, and academic experts in the avionics and missiles domains. The objectives of the workshop were to elicit software technology challenges and identify potential investment opportunities. The workshop participants were divided into five groups, three groups focused on the avionics domain and two groups focused on the missiles domain. Each workshop participant completed several worksheets reflecting their views on the challenges and investment opportunities in their group's domain. This report contains the worksheets completed by the workshop participants.
DTIC
Avionics; Computer Programs; Missiles;

N96-15392# Hungarian Academy of Sciences, Budapest (Hungary). Computer and Automation Research Inst.
Identification for robust control Final Report, Mar. 1994 - Jun. 1995
Keviczky, Laszlo; 30 Jun. 1995 20 p
Contract(s)/Grant(s): (WK2Q6C-7235-MA01)
Report No.(s): (AD-A297347) Avail: CASI HC A03/MF A01

Since 1978, there has been a history of successful cooperation between control researchers at the University of Minnesota and the Hungarian Academy of Sciences. This cooperative research effort was initially sponsored by the National Science Foundation in the late 1970's and early 1980's and later it has continued on an informal basis to the present. One of the most important areas of research in control theory is the design of feedback controllers for systems which have significant uncertainties in the plant. These uncertainties can result from a lack of precision in mathematical modeling of the plant and/or changes in the plant parameters with time. Two main techniques for design of controllers for systems with significant uncertainties are robust and adaptive control theories. System identification is an important tool in both techniques as well as in many other control design methods. The US cooperating partner has a long experience in designing high performance robust control systems (helicopter flight control, supermaneuverable aircraft control, missile autopilots, etc.). The Hungarian partner has implemented several high performance adaptive controllers for complex processes (national load-frequency control system, chemical composition control at cement raw material handling, combined fineness and effectiveness control at closed circuit grinding mills, etc.). Both sides have long experience in modeling, structure and parameter estimation of sophisticated dynamic systems and have obtained significant achievements in robust control methodologies.
DTIC
Adaptive Control; Aircraft Control; Control Systems Design; Feedback Control; Flight Control; Mathematical Models; Optimal Control; System Identification;

N96-15450*# Allied-Signal Technical Services Corp., Morristown, NJ.
A packet data compressor c61
Grunes, Mitchell R.; and Choi, Junho; In NASA. Goddard Space Flight Center, The 1995 Science Information Management and Data Compression Workshop 1 Oct. 1995 p 35-44 (For primary document see N96-15446 03-59) Avail: CASI HC A02/MF A02

We are in the preliminary stages of creating an operational system for losslessly compressing packet data streams. The end goal is to reduce costs. Real world constraints include transmission in the presence of error, tradeoffs between the costs of compression and the costs of transmission and storage, and imperfect knowledge of the data streams to be transmitted. The overall method is to bring together packets of similar type, split the data into bit fields, and test a large number of compression algorithms. Preliminary results are very encouraging, typically offering compression factors substantially higher than those obtained with simpler generic byte stream compressors, such as Unix Compress and HA 0.98.
Author
Algorithms; Compressors; Data Compression; Data Flow Analysis; Packet Transmission; Packets (communication);

N96-15636# National Aerospace Lab., Bangalore (India). Flight Mechanics and Control Div.
MIS: Menu Initialisation Software
Shubha, G.; 1 Feb. 1995 60 p Originial contains color illustrations
Report No.(s): (NAL-PD-FC-9504; NIPS-95-06418) Avail: CASI HC A04/MF A01

The flight of an aircraft can be studied by simulating it on a computer. The flight behavior is largely dependent on flight conditions, atmospheric conditions, and control inputs. These conditions are represented as a set of data which have to be initialized before the start of flight. This initialization is accomplished using the Menu Initialization Software - MIS. MIS is a Graphical User Interface developed to enable the data initialization process easy by making the dataset transparent to the user. This document describes the features of MIS, its usage along with examples.
Author
Applications Programs (computers); C (programming Language); Computer Programming; Computerized Simulation; Flight Characteristics; Flight Simulation; Graphical User Interface; Software Engineering;

N96-15740# National Aerospace Lab., Bangalore (India). Computational and Theoretical Fluid Dynamics Div.
Small aircraft information system
Premalatha, P. Ramamoorthy; 1 Mar. 1995 25 p
Report No.(s): (NAL-PD-CF-9503; NIPS-95-06420) Avail: CASI HC A03/MF A01

The emergence of computer science packages such as database management systems, 2D and 3D graphics and image capturing and displaying utilities has provided a sharp edge to the design efforts of aerospace vehicles. With large computing power available on desktop computers and high level languages such as 'C' for providing user-friendly interfaces, the design effort has become all the more profound. In this report the development of customized software package called Small Aircraft Information System (SAI System) is described. SAI System is a database management system, managing the information flow among a number of modules such as data entry, information retrieval, display, etc. The entire package is written in 'C' without using any of the existing database management packages such as dBase 3+, Foxpro, Clipper, etc. The package is applied to the design of a small aircraft database containing the data for 44 small aircraft and to choose an aircraft for given design specifications. Appropriate queries choose an aircraft for design purposes. Unlike other existing databases, the novel feature of the present software is the display of the prototype aircraft's image on the computer. Input and retrieval facilities for the image are provided. Yet another feature of the present package is the provision of a memo type of field where important details pertaining to the aircraft can be obtained.
Derived from text
Aerospace Vehicles; Aircraft Equipment; Applications Programs (computers); C (programming Language); Computer Programming; Computer Systems Design; Data Base Management Systems; Display Devices;

16 PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

N96-14475 Institut Franco-Allemand de Recherches, Saint-Louis (France).
BVI noise for the AH-1/OLS model rotor in forward flight, taking into account the rotor stand in the DNW wind tunnel Final Report
Schaffar, M.; Haertig, J.; and Gnemmi, P.; Oct. 1994 16p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
Report No.(s): (PB95-255154) Avail: CASI HC A03

This paper examines whether the rotor stand has to be taken into account in the Blade-vortex interaction (BVI) noise calculation for the AH-1/OLS model rotor tested in the DNW wind tunnel. The tests show that the presence of the stand changes the heights of the blade/vortex interactions from +0.2 to 0.5 chords, increases the retreating blade/wake interaction and the corresponding noise emission (+3 to 5 dB), but changes only slightly the noise emission corresponding to the advancing blade/wake interaction.
NTIS

Aeroacoustics; Aerodynamic Noise; Blade Slap Noise; Blade-vortex Interaction; Horizontal Flight; Models; Noise Prediction (aircraft); Rotary Wings; Rotor Aerodynamics;

N96-14966 Foundation for Scientific and Industrial Research, Trondheim (Norway). Acoustics Research Center.

Topography influence on aircraft noise propagation, as implemented in the Norwegian prediction model, NORTIM

Olsen, H.; Liasjoe, K. H.; and Granoeien, I. L. N.; 23 May 1995 42 p

Report No.(s): (PB95-257200; STF40-A95038) Avail: Issuing Activity (National Technical Information Service (NTIS)

Prediction of aircraft noise around airports traditionally assumes horizontal soft ground. This report describes a new calculation program, NORTIM, that automatically takes into account the influence of topography on aircraft noise propagation. It is directly based on INM version 4.11 with respect to input data formats and basic algorithms. NORTIM is capable to calculate all the most commonly used L(eq) and L(Amax) based noise descriptors, including the influence of terrain height, terrain slope variation, terrain surface properties, and shielding effects. The development of NORTIM is made in close connection to a NATO CCMS effort in this field, ensuring international cooperation on algorithms, data compatibility and comprehensive verification measurements.

NTIS

Aircraft Noise; Computer Programs; Computerized Simulation; Noise Prediction; Noise Propagation; Terrain; Topography;

N96-15219*# Metzger Technology Services, Simsbury, CT.

An assessment of propeller aircraft noise reduction technology

Metzger, F. Bruce; 1 Aug. 1995 124 p

Contract(s)/Grant(s): (RTOP 538-03-11-01; NASA ORDER L-50418-D)

Report No.(s): (NASA-CR-198237; NAS 1.26:198237; NIPS-95-06245) Avail: CASI HC A06/MF A02

This report is a review of the literature regarding propeller airplane far-field noise reduction. Near-field and cabin noise reduction are not specifically addressed. However, some of the approaches used to reduce far-field noise produce beneficial effects in the near-field and in the cabin. The emphasis is on propeller noise reduction but engine exhaust noise reduction by muffling is also addressed since the engine noise becomes a significant part of the aircraft noise signature when propeller noise is reduced. It is concluded that there is a substantial body of information available that can be used as the basis to reduce propeller airplane noise. The reason that this information is not often used in airplane design is the associated weight, cost, and performance penalties. It is recommended that the highest priority be given to research for reducing the penalties associated with lower operating RPM and propeller diameter while increasing the number of blades. Research to reduce engine noise and explore innovative propeller concepts is also recommended. Author

Aircraft Design; Aircraft Engines; Aircraft Noise; Engine Noise; Far Fields; Noise Reduction; Propeller Noise; Propellers;

N96-15985*# Metzger Technology Services, Simsbury, CT.

A review of propeller noise prediction methodology: 1919-1994

Metzger, F. Bruce; Jun. 1995 120 p

Contract(s)/Grant(s): (RTOP 538-03-11-01; NASA ORDER L-50418-D)

Report No.(s): (NASA-CR-198156; NAS 1.26:198156) Avail: CASI HC A06/MF A02

This report summarizes a review of the literature regarding propeller noise prediction methods. The review is divided into six sections: (1) early methods; (2) more recent methods based on earlier theory; (3) more recent methods based on the Acoustic Analogy; (4) more recent methods based on Computational Acoustics; (5) empirical methods; and (6) broadband methods. The report concludes that there are a large number of noise prediction procedures available which vary markedly in complexity. Deficiencies in accuracy of methods in many cases may be related, not to the methods themselves, but the accuracy and detail of the aerodynamic inputs used to calculate noise. The steps recommended in the report to provide accurate and easy to use prediction methods are: (1) identify reliable test data; (2) define and conduct test programs to fill gaps in the existing data base; (3) identify the most promising prediction methods; (4) evaluate promising prediction methods relative to the data base; (5) identify and correct the weaknesses in the prediction methods, including lack of user friendliness, and include features now available only in research codes; (6) confirm the accuracy of improved prediction methods to the data base; and (7) make the methods widely available and provide training in their use.

Author

Histories; Noise Prediction; Noise Reduction; Prediction Analysis Techniques; Prop-fan Technology; Propeller

Blades; Propeller Efficiency; Propeller Fans; Propeller Noise; Turboprop Engines;

17 SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

N96-14632# Oak Ridge National Lab., TN.
PMB-Waste: An analysis of fluidized bed thermal treatment
Gat, U.; Kass, M. D.; and Lloyd, D. B.; 1995 4 p Presented at the Department of Defense (DOD) Conference on Industry Advanced Coating Removal, Albuquerque, NM, 23-25 May 1995
Contract(s)/Grant(s): (DE-AC05-84OR-21400)
Report No.(s): (DE95-014580; CONF-9505255-1) Avail: CASI HC A01/MF A01

A fluidized bed treatment process was evaluated for solid waste from plastic media blasting (PMB) of aircraft protective coating. The treatment objective is to decompose and oxidize all organic components, and concentrate all the hazardous metals in the ash. The reduced volume and mass are expected to reduce disposal cost. A pilot test treatment was done in an existing fluidized bed equipped with emissions monitors, and emissions within regulatory requirements were demonstrated. A economic analysis of the process is inconclusive due to lack of reliable cost data of disposal without thermal treatment.
DOE
Environment Effects; Pollution Monitoring; Protective Coatings; Solid Wastes; Waste Disposal;

N96-14673# Naval Postgraduate School, Monterey, CA.
Life cycle SDLM cost models of the E-2C Hawkeye under the ASPA program M.S. Thesis
McFerren, Michael G.; Mar. 1995 63 p
Report No.(s): (AD-A298419) Avail: CASI HC A04/MF A01

Standard Depot Level Maintenance (SDLM) was conducted on every E-2C in the United States Navy's inventory on a given time interval. The Aircraft Service Period Adjustment (ASPA) implemented in 1985 was designed to reduce the life cycle cost of maintaining an airplane by reducing the number of times the airplane is inducted into SDLM. This changed the maintenance policy from one that is based on a time interval to one that is based on inspection results of airplane material condition. This thesis investigates the long term effect of the ASPA program on airplane life cycle SDLM costs. Through the use of regression models built from data obtained from NADEP North Island San Diego, this thesis analyzes the effect of tour length (the time between SDLM inductions) on both the individual SDLM cost and the life cycle SDLM costs of a typical E-2C. Graphical analysis shows the optimal tour length for a typical E-2C that minimizes the life cycle SDLM costs.
DTIC
Aircraft Maintenance; Cost Analysis; E-2 Aircraft; Life (durability); Life Cycle Costs; Reconnaissance Aircraft;

N96-15458*# Computer and Information Sciences, Inc., Denton, TX.
Dissemination of compressed satellite imagery within the Navy SPAWAR Central Site Product Display environment c82
Kiselyov, Oleg; and Fisher, Paul; In NASA. Goddard Space Flight Center, The 1995 Science Information Management and Data Compression Workshop 1 Oct. 1995 p 123-130 Sponsored in cooperation with ARO (For primary document see N96-15446 03-59)
Contract(s)/Grant(s): (N00039-94-C-0013) Avail: CASI HC A02/MF A02

This paper presents a case study of integration of compression techniques within a satellite image communication component of an actual tactical weather information dissemination system. The paper describes history and requirements of the project, and discusses the information flow, request/reply protocols, error handling, and, especially, system integration issues: specification of compression parameters and the place and time for compressor/decompressor plug-ins. A case for a non-uniform compression of satellite imagery is presented, and its implementation in the current system id demonstrated. The paper gives special attention to challenges of moving the system towards the use of standard, non-proprietary protocols (smtp and http) and new technologies (OpenDoc), and reports the ongoing work in this direction.
Author
Case Histories; Communication Equipment; Data Compression; Imaging Techniques; Information Dissemination; Satellite Communication; Satellite Imagery; Systems Integration; Weather Data Recorders;

18 SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.

No abstracts in this category.

19 GENERAL

No abstracts in this category.

Subject Term Index

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

W

X

Y

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Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in Energy Research Abstracts. Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center—Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

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Avail: Fachinformationszentrum Karlsruhe. Gesellschaft für wissenschaftlich-technische Information mbH 76344 Eggenstein-Leopoldshafen, Germany.

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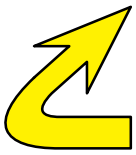

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