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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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

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02 Aerodynamics **1**

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

03 Air Transportation and Safety **4**

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

04 Aircraft Communications and Navigation **5**

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

05 Aircraft Design, Testing and Performance **6**

Includes aircraft simulation technology.

06 Aircraft Instrumentation **8.**

Includes cockpit and cabin display devices; and flight instruments.

07 Aircraft Propulsion and Power **9**

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

08 Aircraft Stability and Control **11**

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

09 Research and Support Facilities (Air) **13**

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

10 Astronautics **14**

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

11 Chemistry and Materials **14**

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18 Space Sciences N.A.

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19 General N.A.

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Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 342)

FEBRUARY 21, 1997

02
AERODYNAMICS

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

19970004691 Technische Hogeschool, Aerospace Engineering, Delft, Netherlands
Inverse 3-D Aerodynamic Design over the Flight Envelope
Middel, J., Technische Hogeschool, Netherlands; Apr. 1995; 27p; In English; Original contains color illustrations
Report No.(s): LR-803; TUD/LR/A2L; ISBN 90-5623-037-0; Copyright; Avail: Issuing Activity(Delft Univ. of Technology, Aerospace Engineering, P. O. Box 5058, 2600 GB Delft, The Netherlands), Hardcopy, Microfiche

A tool for the aerodynamic design of complex three dimensional configurations with prescribed surface pressure distributions is presented. It is basically a procedure to determine amplitudes of (local) changes of a baseline geometry that yields a best fit through user prescribed target pressure distributions, considering a series of flight conditions. This method is based on a 3-D linear potential flow (panel) method and grants the user full control over where and how the geometry is changed. An example case is provided.
Author
Panel Method (Fluid Dynamics); Flight Envelopes; Pressure Distribution; Three Dimensional Flow; Three Dimensional Models; Potential Flow

19970004933 NASA Langley Research Center, Hampton, VA USA
Investigation of Low-Reynolds-Number Rocket Nozzle Design Using PNS-Based Optimization Procedure
Hussaini, M. Moin, NASA Langley Research Center, USA; Korte, John J., NASA Langley Research Center, USA; Nov. 1996; 13p; In English
Contract(s)/Grant(s): RTOP 522-31-31-02
Report No.(s): NASA-TM-110295; NAS 1.15:110295; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An optimization approach to rocket nozzle design, based on computational fluid dynamics (CFD) methodology, is investigated for low-Reynolds-number cases. This study is undertaken to determine the benefits of this approach over those of classical design processes such as Rao's method. A CFD-based optimization procedure, using the parabolized Navier-Stokes (PNS) equations, is used to design conical and contoured axisymmetric nozzles. The advantage of this procedure is that it accounts for viscosity during the design process; other processes make an approximated boundary-layer correction after an inviscid design is created. Results showed significant improvement in the nozzle thrust coefficient over that of the baseline case; however, the unusual nozzle design necessitates further investigation of the accuracy of the PNS equations for modeling expanding flows with thick laminar boundary layers.
Author
Computational Fluid Dynamics; Navier-Stokes Equation; Nozzle Design; Rocket Nozzles; Low Reynolds Number; Nozzle Thrust Coefficients

19970005033 NASA Johnson Space Center, Houston, TX USA
Wind Tunnel Tests of an Inflatable Airplane
Oct. 09, 1996; In English; Videotape: 32 min. playing time, in color, with sound
Report No.(s): NASA-TM-111830; L-1642; NONP-NASA-VT-97-1997005936; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

In this video a wind tunnel investigation of aerodynamic and structural deflection characteristics of an inflatable airplane is shown. The film includes scenarios during wind tunnel tests of an inflatable airplane in the Langley Full Scale Tunnel with the

main objective of obtaining load factors prior to wing buckle of 4.5 to 5.0 g. The inflation pressure during the test was indicated to be 7.0 psi.
CASI
Inflatable Structures; Wings; Buckling; Deflection; Aerodynamic Stalling; Aerodynamic Stability; Aerodynamic Loads; Aerodynamic Characteristics

19970005357 NASA Dryden Flight Research Center, Edwards, CA USA
F-15B/Flight Test Fixture 2: A Test Bed for Flight Research
Richwine, David M., NASA Dryden Flight Research Center, USA; Dec. 1996; 54p; In English
Contract(s)/Grant(s): RTOP 505-68-52
Report No.(s): NASA-TM-4782; H-2113; NAS 1.15:4782; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
NASA Dryden Flight Research Center has developed a second-generation flight test fixture for use as a generic test bed for aerodynamic and fluid mechanics research. The Flight Test Fixture 2 (FTF-2) is a low-aspect-ratio vertical fin-like shape that is mounted on the centerline of the F-I5B lower fuselage. The fixture is designed for flight research at Mach numbers to a maximum of 2.0. The FTF-2 is a composite structure with a modular configuration and removable components for functional flexibility. This report documents the flow environment of the fixture, such as surface pressure distributions and boundary-layer profiles, throughout a matrix of conditions within the F-15B/FTF-2 flight envelope. Environmental conditions within the fixture are presented to assist in the design and testing of future avionics and instrumentation. The intent of this document is to serve as a user's guide and assist in the development of future flight experiments that use the FTF-2 as a test bed. Additional information enclosed in the appendices has been included to assist with more detailed analyses, if required.
Author
F-15 Aircraft; Research Aircraft; Flight Tests; Flight Envelopes; Flow Visualization; Fins

19970006701 Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA
Application of a Third Order Upwind Scheme to Viscous Flow over Clean and Iced Wings
Bangalore, A., Georgia Inst. of Tech., USA; Phaengsook, N., Georgia Inst. of Tech., USA; Sankar, L. N., Georgia Inst. of Tech., USA; 1994; 10p; In English; 32nd; Aerospace Sciences, 10-13 Jan. 1994, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAG3-768
Report No.(s): NASA-CR-202616; NAS 1.26:202616; AIAA Paper 94-0485; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A01, Microfiche
A 3-D compressible Navier-Stokes solver has been developed and applied to 3-D viscous flow over clean and iced wings. This method uses a third order accurate finite volume scheme with flux difference splitting to model the inviscid fluxes, and second order accurate symmetric differences to model the viscous terms. The effects of turbulence are modeled using a Kappa-epsilon model. In the vicinity of the sold walls the kappa and epsilon values are modeled using Gorski's algebraic model. Sampling results are presented for surface pressure distributions, for untapered swept clean and iced wings made of NACA 0012 airfoil sections. The leading edge of these sections is modified using a simulated ice shape. Comparisons with experimental data are given.
Author
Airfoil Profiles; Flux Difference Splitting; Navier-Stokes Equation; Pressure Distribution; Upwind Schemes (Mathematics); Viscous Flow; Aircraft Icing; Inviscid Flow

19970006702 NASA Langley Research Center, Hampton, VA USA
Effects of Fin Leading Edge Sweep on Shock-Shock Interaction at Mach 6
Berry, Scott A., NASA Langley Research Center, USA; Nowak, Robert J., NASA Langley Research Center, USA; 1996; 15p; In English; 34th; Aerospace Sciences, 15-18 Jan. 1996, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA-TM-111790; NAS 1.15:111790; AIAA Paper 96-0230; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche
The effects of fin leading edge sweep on peak heating rates due to shock-shock interaction have been experimentally examined in the Langley 20-Inch Mach 6 Tunnel. The shock interaction was produced by the intersection of a planar incident shock (16.8 deg shock angle relative to the freestream, generated by a 9 deg wedge) with the bow shock formed around a O.5-inch diameter cylindrical leading edge fin. Heating distributions along the leading edge stagnation line have been obtained using densely spaced thin film resistive-type sensors. Schlieren images were obtained to illustrate the very complex shock-shock interactions. The fin leading edge sweep angle was varied from 15-degrees swept back to 45-degrees swept forward for a freestream unit

Reynolds number of 2 x 10(exp 6)/ft. Two models were utilized during the study, one with 0.025-inch spacing between gage centers, and the other 0.015-inch spacing. Gage spatial resolution on the order of 0.015-in appeared to accurately capture the narrow spike in heating. Peak heating due to shock interaction was maximized when the fin was swept forward 15 deg and 25 deg, both promoting augmentations about 7 times the baseline value. The schlieren images for these cases revealed Type 4 and Type 3 interactions, respectively.
Author
Leading Edge Sweep; Shock Wave Interaction; Wind Tunnel Tests; Hypersonic Speed; Reynolds Number

19970006726 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
A PDE Sensitivity Equation Method for Optimal Aerodynamic Design
Borggaard, Jeff, Institute for Computer Applications in Science and Engineering, USA; Burns, John, Institute for Computer Applications in Science and Engineering, USA; Jun. 1996; 41p; In English
Contract(s)/Grant(s): NAS1-19480
Report No.(s): NASA-CR-198349; NAS 1.26:198349; AD-A313186; ICASE-96-44; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of gradient based optimization algorithms in inverse design is well established as a practical approach to aerodynamic design. A typical procedure uses a simulation scheme to evaluate the objective function (from the approximate states) and its gradient, then passes this information to an optimization algorithm. Once the simulation scheme (CFD flow solver) has been selected and used to provide approximate function evaluations, there are several possible approaches to the problem of computing gradients. One popular method is to differentiate the simulation scheme and compute design sensitivities that are then used to obtain gradients. Although this black-box approach has many advantages in shape optimization problems, one must compute mesh sensitivities in order to compute the design sensitivity. In this paper, we present an alternative approach using the PDE sensitivity equation to develop algorithms for computing gradients. This approach has the advantage that mesh sensitivities need not be computed. Moreover, when it is possible to use the CFD scheme for both the forward problem and the sensitivity equation, then there are computational advantages. An apparent disadvantage of this approach is that it does not always produce consistent derivatives. However, for a proper combination of discretization schemes, one can show asymptotic consistency under mesh refinement, which is often sufficient to guarantee convergence of the optimal design algorithm. In particular, we show that when asymptotically consistent schemes are combined with a trust-region optimization algorithm, the resulting optimal design method converges. We denote this approach as the sensitivity equation method. The sensitivity equation method is presented, convergence results are given and the approach is illustrated on two optimal design problems involving shocks.
DTIC
Algorithms; Computerized Simulation; Grid Generation (Mathematics); Partial Differential Equations; Convergence

19970007025 NASA Langley Research Center, Hampton, VA USA
Prediction of Complex Aerodynamic Flows with Explicit Algebraic Stress Models
Abid, Ridha, High Technology Corp., USA; Morrison, Joseph H., Analytical Services and Materials, Inc., USA; Gatski, Thomas B., NASA Langley Research Center, USA; Speziale, Charles G., Boston Univ., USA; 1996; 14p; In English; 34th; Aerospace Sciences, 15-18 Jan. 1996, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS1-19831; NAS1-20059; N00014-94-1-0088
Report No.(s): NASA-CR-202580; NAS 1.26:202580; AIAA Paper 96-0565; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

An explicit algebraic stress equation, developed by Gatski and Speziale, is used in the framework of K-epsilon formulation to predict complex aerodynamic turbulent flows. The nonequilibrium effects are modeled through coefficients that depend nonlinearly on both rotational and irrotational strains. The proposed model was implemented in the ISAAC Navier-Stokes code. Comparisons with the experimental data are presented which clearly demonstrate that explicit algebraic stress models can predict the correct response to nonequilibrium flow.
Author
Aerodynamics; Turbulent Flow; K-Epsilon Turbulence Model; Computational Fluid Dynamics

03
AIR TRANSPORTATION AND SAFETY

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

19970004686 NASA Ames Research Center, Moffett Field, CA USA
A System Concept for Facilitating User Preferences in En Route Airspace
Vivona, R. A., Sterling Software, Inc., USA; Ballin, M. G., NASA Ames Research Center, USA; Green, S. M., NASA Ames Research Center, USA; Bach, R. E., NASA Ames Research Center, USA; McNally, B. D., NASA Ames Research Center, USA; Nov. 1996; 28p; In English
Contract(s)/Grant(s): RTOP 505-64-36
Report No.(s): NASA-TM-4763; NAS 1.15:4763; A-962788; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Federal Aviation Administration is trying to make its air traffic management system more responsive to the needs of the aviation community by exploring the concept of 'free flight' for aircraft flying under instrument flight rules. A logical first step toward free flight could be made without significantly altering current air traffic control (ATC) procedures or requiring new airborne equipment by designing a ground-based system to be highly responsive to 'user preference' in en route airspace while providing for an orderly transition to the terminal area. to facilitate user preference in all en route environments, a system based on an extension of the Center/TRACON Automation System (CTAS) is proposed in this document. The new system would consist of two integrated components. An airspace tool (AT) focuses on unconstrained en route aircraft (e.g., not transitioning to the terminal airspace), taking advantage of the relatively unconstrained nature of their flights and using long-range trajectory prediction to provide cost-effective conflict resolution advisories to sector controllers. A sector tool (ST) generates efficient advisories for all aircraft, with a focus on supporting controllers in analyzing and resolving complex, highly constrained traffic situations. When combined, the integrated AT/ST system supports user preference in any air route traffic control center sector. The system should also be useful in evaluating advanced free-flight concepts by serving as a test bed for future research. This document provides an overview of the design concept, explains its anticipated benefits, and recommends a development strategy that leads to a deployable system.
Author
Free Flight; Flight Management Systems; Systems Integration; Automated En Route ATC

19970004822 Research Triangle Inst., Research Triangle Park, NC USA
Performance of the NASA Airborne Radar with the Windshear Database for Forward-Looking Systems ***Final Report***
Switzer, George F., Research Triangle Inst., USA; Britt, Charles L., Research Triangle Inst., USA; Sep. 1996; 85p; In English
Contract(s)/Grant(s): NAS1-18925; RTOP 505-64-12-53
Report No.(s): NASA-CR-201607; NAS 1.26:201607; DOT/FAA/ND-96/2; RTI/4500/030-01F; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This document describes the simulation approach used to test the performance of the NASA airborne windshear radar. An explanation of the actual radar hardware and processing algorithms provides an understanding of the parameters used in the simulation program. This report also contains a brief overview of the NASA airborne windshear radar experimental flight test results. A description of the radar simulation program shows the capabilities of the program and the techniques used for certification evaluation. Simulation of the NASA radar is comprised of three steps. First, the choice of the ground clutter data must be made. The ground clutter is the return from objects in or nearby an airport facility. The choice of the ground clutter also dictates the aircraft flight path since ground clutter is gathered while in flight. The second step is the choice of the radar parameters and the running of the simulation program which properly combines the ground clutter data with simulated windshear weather data. The simulated windshear weather data is comprised of a number of Terminal Area Simulation System (TASS) model results. The final step is the comparison of the radar simulation results to the known windshear data base. The final evaluation of the radar simulation is based on the ability to detect hazardous windshear with the aircraft at a safe distance while at the same time not displaying false alerts.
Author
Airborne Radar; Wind Shear; Data Acquisition; Radar Echoes; Meteorological Parameters; Computerized Simulation; Doppler Radar

19970005329 Ohio State Univ., Columbus, OH USA
Developing the Personal Minimums Tool for Managing Risk During Preflight Go/No-Go Decisions ***Final Report***
Kirkbride, Larry A., Ohio State Univ., USA; Jensen, Richard S., Ohio State Univ., USA; Chubb, Gerald P., Ohio State Univ., USA; Hunter, David R., Federal Aviation Administration, USA; Jul. 1996; 49p; In English

Report No.(s): AD-A313639; DOT/FAA/AM-96/19; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the preliminary design of a structured method for pilots to construct personal minimums related to safety for use during preflight decision making. The design uses a three-step process by which individual pilots prepare personal minimums that apply to the scope of their routine flight activities. The approach encourages voluntary compliance with the self-generated personal minimums guidelines prepared in checklist form.

DTIC

Risk; Management; Decision Making; Tools; Pilots; Safety

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

19970005003 NASA Ames Research Center, Moffett Field, CA USA

Knowledge-Based Scheduling of Arrival Aircraft in the Terminal Area

Krzeczowski, K. J., NASA Ames Research Center, USA; Davis, T., NASA Ames Research Center, USA; Erzberger, H., NASA Ames Research Center, USA; Lev-Ram, Israel, Sterling Software, Inc., USA; Bergh, Christopher P., Massachusetts Inst. of Tech., USA; 1995; 12p; In English; Guidance, Navigation, and Control, 7-10 Aug. 1995, Baltimore, MD, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): NASA-TM-111952; NAS 1.15:111952; AIAA Paper 95-3366; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

A knowledge based method for scheduling arrival aircraft in the terminal area has been implemented and tested in real time simulation. The scheduling system automatically sequences, assigns landing times, and assign runways to arrival aircraft by utilizing continuous updates of aircraft radar data and controller inputs. The scheduling algorithm is driven by a knowledge base which was obtained in over two thousand hours of controller-in-the-loop real time simulation. The knowledge base contains a series of hierarchical 'rules' and decision logic that examines both performance criteria, such as delay reductions, as well as workload reduction criteria, such as conflict avoidance. The objective of the algorithm is to devise an efficient plan to land the aircraft in a manner acceptable to the air traffic controllers. This paper describes the scheduling algorithms, gives examples of their use, and presents data regarding their potential benefits to the air traffic system.

Author

Air Traffic Control; Computerized Simulation; Knowledge Based Systems; Decision Theory; Workloads (Psychophysiology); Scheduling; Airports; Algorithms

19970005004 NASA Ames Research Center, Moffett Field, CA USA

Descent Advisor Preliminary Field Test

Green, Steven M., NASA Ames Research Center, USA; Vivona, Robert A., Sterling Software, Inc., USA; Sanford, Beverly, Sterling Software, Inc., USA; 1995; 12p; In English; Guidance, Navigation, and Control, 7-10 Aug. 1995, Baltimore, MD, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): NASA-TM-111929; NAS 1.15:111929; AIAA Paper 95-3368; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

A field test of the Descent Advisor (DA) automation tool was conducted at the Denver Air Route Traffic Control Center in September 1994. DA is being developed to assist Center controllers in the efficient management and control of arrival traffic. DA generates advisories, based on trajectory predictions, to achieve accurate meter-fix arrival times in a fuel efficient manner while assisting the controller with the prediction and resolution of potential conflicts. The test objectives were: (1) to evaluate the accuracy of DA trajectory predictions for conventional and flight-management system equipped jet transports, (2) to identify significant sources of trajectory prediction error, and (3) to investigate procedural and training issues (both air and ground) associated with DA operations. Various commercial aircraft (97 flights total) and a Boeing 737-100 research aircraft participated in the test. Preliminary results from the primary test set of 24 commercial flights indicate a mean DA arrival time prediction error of 2.4 seconds late with a standard deviation of 13.1 seconds. This paper describes the field test and presents preliminary results for the commercial flights.

Author

Air Traffic Control; Commercial Aircraft; Predictions; Error Analysis; Approach Control; Airborne Radar Approach; Automated En Route ATC

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970004665 Naval Research Lab., Ocean Sciences Branch, Arlington, VA USA
Fungal Contamination of H-53 Aircraft ***Final Report***
Lavoie, Dennis M., Naval Research Lab., USA; Little, Brenda J., Naval Research Lab., USA; Mar. 15, 1996; 32p; In English; Original contains color plates
Report No.(s): AD-A308279; NRL/MR/7333--96-7725; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Fungal contamination of aircraft interior surfaces has the potential to influence corrosion of airframes, cause acute or chronic health problems in crews, and causes excessive maintenance efforts. Nine genera of microfungi were isolated from H-53 aircraft in various stages of the depot maintenance cycle at Naval Aviation Depot, Cherry Point, NC, in October 1995. The results of this study support previous studies that demonstrated a potential for corrosion of unprotected structural aluminum due to fungal and bacterial growth. The most immediate concern, however, appears to be cleaning maintenance procedures because of the waste of manpower and the potential for corrosion damage from unauthorized procedures, particularly the use of bleach to eliminate 'mildew' stains left behind after physical removal of fungal growth. It is not known if mildew staining is a problem specific to the older, lacquer paint or if it occurs on the newer, polyester urethane (polyurethane 36321) paints as well. At least one of the fungi isolated from H-53 interior surfaces is known to discolor paint. No physical degradation of polyurethane and lacquer coatings was observed in this short term study, and standard cleaning procedures with alcohol appeared to remove surface fungi effectively. Recommendations for immediate actions are: (1) continue current procedures to disinfect and clean painted surfaces with possible minor changes, (2) repaint interiors of aircraft undergoing depot maintenance with gloss polyurethane to make cleaning easier, (3) identify additives/inhibitors already proven to be effective by the paint industry for immediate use in problem areas such as bilges and other areas difficult to reach during normal maintenance, and (4) conduct research to further evaluate specific inhibitors of staining fungi.
DTIC
Aircraft Compartments; Contamination; Fungi; Aircraft Maintenance; Biodegradation; H-53 Helicopter; Corrosion

19970004823 NASA Ames Research Center, Moffett Field, CA USA
Wing Leading Edge Joint Laminar Flow Tests
Drake, Aaron, Washington State Univ., USA; Westphal, Russell V., Washington State Univ., USA; Zuniga, Fanny A., NASA Ames Research Center, USA; Kennelly, Robert A., Jr., NASA Ames Research Center, USA; Koga, Dennis J., NASA Ames Research Center, USA; Oct. 1996; 36p; In English
Contract(s)/Grant(s): RTOP 505-59-20
Report No.(s): NASA-TM-4762; NAS 1.15:4762; A-962704; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An F-104G aircraft at NASA's Dryden Flight Research Center has been equipped with a specially designed and instrumented test fixture to simulate surface imperfections of the type likely to be present near the leading edge on the wings of some laminar flow aircraft. The simulated imperfections consisted of five combinations of spanwise steps and gaps of various sizes. The unswept fixture yielded a pressure distribution similar to that of some laminar flow airfoils. The experiment was conducted at cruise conditions typical for business jets and light transports: Mach numbers were in the range 0.5-0.8, and unit Reynolds numbers were 1.5-2.5 million per foot. Skin friction measurements indicated that laminar flow was often maintained for some distance downstream of the surface imperfections. Further work is needed to more precisely define transition location and to extend the experiments to swept-wing conditions and a broader range of imperfection geometries.
Author
Flight Tests; Laminar Flow Airfoils; Leading Edges; Pressure Distribution; Skin Friction; Swept Wings; Transition Flow

19970005122 NASA Langley Research Center, Hampton, VA USA
Subsonic-to-Hypersonic Aerodynamic Characteristics for a Winged, Circular-Body, Single-Stage-to-Orbit Spacecraft Configuration
Phillips, W. P., NASA Langley Research Center, USA; Engelund, W. C., NASA Langley Research Center, USA; 1995; 24p; In English; Applied Aerodynamics, 19-22 Jun. 1995, San Diego, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA-TM-111926; NAS 1.15:111926; AIAA Paper 95-1848; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

Experimental aerodynamic characteristics were obtained for a generic, winged, circular-body, single-stage-to-orbit spacecraft configuration. The baseline configuration was longitudinally stable and trimmable at almost all Mach numbers from 0.15 to 10.0--with the exception occurring at low supersonic speeds. Landing speed and subsonic-to-hypersonic longitudinal stability and control appear to be within design guidelines. Lateral-directional instabilities found over the entire speed range, however, create a problem area for this configuration. Longitudinal aerodynamic predictions made utilizing the Aerodynamic Preliminary Analysis System (APAS) were in qualitative, often quantitative agreement with experimental values.
Author
Aerodynamic Characteristics; Spacecraft Configurations; Subsonic Speed; Supersonic Speed; Hypersonics; Single Stage to Orbit Vehicles; Longitudinal Stability; Controllability

19970005390 Rensselaer Polytechnic Inst., Troy, NY USA
Development of a System for Improved Helicopter Blade Tracking, Phase 2 ***Final Report, Sep. 1992 - Mar. 1995***
Bielawa, Richard L., Rensselaer Polytechnic Inst., USA; Frederickson, Kirk, Rensselaer Polytechnic Inst., USA; Jun. 30, 1995; 78p; In English
Contract(s)/Grant(s): DAAJ02-93-C-0013
Report No.(s): AD-A313337; D-95-1; USAATCOM-TR-95-D-9; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
This report presents the results of a demonstration of an experimental method of determining the flapping moment of inertia of a helicopter rotor blade. The purpose of the work was to validate an approach to measure a parameter which is thought to be a measure of manufacturing quality which relates directly to the blades ability to be flown with minimum vibration without extensive (and costly) adjustment. The accuracy of the method was demonstrated first for a simple prismatic bar. Measurements were then made on UH-60 Black Hawks' recently manufactured blades and a blade with a small mass added. The calculated and empirically estimated flapping moments of inertia for the prismatic bar were in excellent agreement. Calculated and experimentally determined flapping moments of inertia for the UH-6O Black Hawk blades were in satisfactory agreement. The experimental method was shown to be both precise and repeatable. The results presented in the report will serve as the basis for establishing a more production-oriented quality test procedure which could be used for new or repaired main rotor blades to reduce the number of tracking flights required to obtain satisfactory vibration characteristics.
DTIC
Helicopters; Rotary Wings; Moments of Inertia; Accuracy; Vibration

19970005490 NASA Ames Research Center, Moffett Field, CA USA
The Attributes of a Variable-Diameter Rotor System Applied to Civil Tiltrotor Aircraft
Brender, Scott, Texas Univ., USA; Mark, Hans, Texas Univ., USA; Aguilera, Frank, NASA Ames Research Center, USA; [1996]; 126p; In English
Contract(s)/Grant(s): NCC2-5174
Report No.(s): NASA-CR-203092; NAS 1.26:203092; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
The attributes of a variable diameter rotor concept applied to civil tiltrotor aircraft are investigated using the V/STOL aircraft sizing and performance computer program (VASCOMP). to begin, civil tiltrotor viability issues that motivate advanced rotor designs are discussed. Current work on the variable diameter rotor and a theoretical basis for the advantages of the rotor system are presented. The size and performance of variable diameter and conventional tiltrotor designs for the same baseline mission are then calculated using a modified NASA Ames version of VASCOMP. The aircraft are compared based on gross weight, fuel required, engine size, and autorotative performance for various hover disk loading values. Conclusions about the viability of the resulting designs are presented and a program for further variable diameter rotor research is recommended.
Author
Autorotation; V/STOL Aircraft; Aircraft Design; Tilt Rotor Aircraft; Computer Aided Design

19970006667 Naval Postgraduate School, Monterey, CA USA
Reengineering of the F/A-18 Aircraft's Intermediate Level Hydraulic Maintenance
Shanahan, Curt M., Naval Postgraduate School, USA; Jun. 1996; 70p; In English
Report No.(s): AD-A313449; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
The continued down-sizing of the Department of Defense (DoD) into the 21st century and the resulting budget constrained realities will force the Navy to adopt innovative measures to save costs, while not sacrificing readiness. The Navy's immediate future in aviation lies in the readiness of the F/A-IS Hornet aircraft weapons system. Present experience shows the F/A- 18's hydraulic system is not performing effectively and subsequently is one of the top readiness degraders. In this thesis, we analyze reengineering and consolidating duplicate intermediate level F/A- 18 hydraulic system maintenance capabilities. Consolidating the

maintenance of duplicate capabilities into one facility per coast, as we propose for the intermediate maintenance facilities for these hydraulic components, would reduce cost while maintaining readiness. We develop a comparative spreadsheet model to analyze a Prime Intermediate Maintenance Activity (PIMA) operating as a consolidated facility to investigate the effects of consolidating production and its impact on readiness. Based on our analysis, we conclude that the proposed consolidation is a viable option.
DTIC
Management Methods; Aircraft Maintenance; Attack Aircraft; Jet Aircraft

19970006987 NASA Ames Research Center, Moffett Field, CA USA
Computation of Loads on the McDonnell Douglas Advanced Bearingless Rotor
Nguyen, Khanh, NASA Ames Research Center, USA; Lauzon, Dan, McDonnell-Douglas Helicopter Co., USA; Anand, Vaidyanathan, McDonnell-Douglas Helicopter Co., USA; 1994; 10p; 50th; American Helicopter Society Annual Forum, 11-13 May 1994, Washinton, DC, USA
Report No.(s): NASA-TM-111887; NAS 1.15:111887; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A01, Microfiche

Computed results from UMARC and DART analyses are compared with the blade bending moments and vibratory hub loads data obtained from a full-scale wind tunnel test of the McDonnell Douglas five-bladed advanced bearingless rotor. The 5 per-rev vibratory hub loads data are corrected using results from a dynamic calibration of the rotor balance. The comparison between UMARC computed blade bending moments at different flight conditions are poor to fair, while DART results are fair to good. Using the free wake module, UMARC adequately computes the 5P vibratory hub loads for this rotor, capturing both magnitude and variations with forward speed. DART employs a uniform inflow wake model and does not adequately compute the 5P vibratory hub loads for this rotor.
Author
Bearingless Rotors; Loads (Forces); Bending Moments; Blades; Vibratory Loads; Rotor Aerodynamics; Rotary Wings; Finite Element Method

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19970004910 Transportation Systems Center, Cambridge, MA USA
Economic Analysis of Local Area Augmentation System and Alternative Architectures ***Final Report, Dec. 1995 - Feb. 1996***
Prabhakar, Anand S., Transportation Systems Center, USA; Mar. 1996; 70p; In English
Report No.(s): AD-A308065; DOT-VNTSC-RSPA-96-1; DOT/FAA/SD400-96/1; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The objective of this study has been to perform an economic comparison by conducting a cost-benefit analysis (CBA) of five Local Area Augmentation System (LAAS) and alternative architectures. The five architectures chosen by the FAA for the study are: Pseudolite Kinematic LAAS, Wide-Lane Kinematic LAAS, Code-Based LAAS, instrument Landing System (ILS), and the LAAS-Glide Slope System. A comparison of architectures based on the benefit/cost (B/C) ratio and cost- effectiveness criterion indicates that the Code-Based LAAS architecture has, by far, the highest B/C ratio of 4.0 and the lowest life-cycle cost of $860.9 million over a 15-year time horizon. The B/C ratios of other non-ILS architectures are in the range of 3.4 to 3.7, and the life cycle costs in the range of $946.5 million to $1,014.6 million. For the reference ILS architecture, the study estimates a low B/C ratio of 0.4 and the life cycle cost of $921.2 million. The Latter cost is not much different from other architecture life cycle costs, despite the exclusion of the substantial sunk cost of existing runway ILS and aircraft avionics equipment.
DTIC
Economic Analysis; Global Positioning System; Civil Aviation; Instrument Landing Systems; Glide Paths; Avionics; Cost Effectiveness

19970005360 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA USA
Integration of Multiple Non-Normal Checklist Procedures into a Single Checklist Procedure for Transport Aircraft: A Preliminary Investigation
Foernsler, Lynda J., National Aeronautics and Space Administration. Langley Research Center, USA; Oct. 1996; 40p; In English
Contract(s)/Grant(s): RTOP 522-14-11-01
Report No.(s): NASA-TM-110290; NAS 1.15:110290; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Checklists are used by the flight crew to properly configure an aircraft for safe flight and to ensure a high level of safety throughout the duration of the flight. In addition, the checklist provides a sequential framework to meet cockpit operational requirements, and it fosters cross-checking of the flight deck configuration among crew members. This study examined the feasibility of integrating multiple checklists for non-normal procedures into a single procedure for a typical transport aircraft. For the purposes of this report, a typical transport aircraft is one that represents a midpoint between early generation aircraft (B-727/737-200 and DC-10) and modern glass cockpit aircraft (B747-400/777 and MD-11). In this report, potential conflicts among non-normal checklist items during multiple failure situations for a transport aircraft are identified and analyzed. The non-normal checklist procedure that would take precedence for each of the identified multiple failure flight conditions is also identified. The rationale behind this research is that potential conflicts among checklist items might exist when integrating multiple checklists for non-normal procedures into a single checklist. As a rule, multiple failures occurring in today's highly automated and redundant system transport aircraft are extremely improbable. In addition, as shown in this analysis, conflicts among checklist items in a multiple failure flight condition are exceedingly unlikely. The possibility of a multiple failure flight condition occurring with a conflict among checklist items is so remote that integration of the non-normal checklists into a single checklist appears to be a plausible option.
Author
Flight Conditions; Transport Aircraft; MD 11 Aircraft; Flight Crews; Cockpits

07
AIRCRAFT PROPULSION AND POWER

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

19970004784 Imperial Coll. of Science and Technology, London, UK
Oscillations in Gas-Turbine Combustors; Control of Rumble, Pattern Factor and Emissions ***Interim Report***
Whitlaw, J. H., European Research Office (US Army), UK; Apr. 01, 1996; 1p; In English
Contract(s)/Grant(s): N68171-95-C-9140
Report No.(s): AD-A308200; R/D-7644-AN-01; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
The experiments with kerosene fuel have been stopped temporarily and the results examined. It i s evident that NO(X) reductions up to 50% can be achieved with oscillation of the fuel, and that the amplitudes associated with reductions of this magnitude are difficult to achieve and may be undesirable in practice. Improvements in pattern factor can also be achieved, usually when the original pattern factor is poor, and are largest with low frequency oscillations as might be expected. The T-vaporiser used for kerosene fueling of the gas-turbine sector has been replaced by a double jet arrangement to allow the use of gaseous fuel and preliminary experiments show first that the pattern factors are poor as a result of the poorer mixing associated with forward injection of fuel and second that reduction is NOx emissions are again present with magnitudes of the order of 20%. Perhaps most promising is the application of oscillations to neighbouring fueling devices, but out of phase, so that the near field is subject to the oscillations and the far field is not. This appears to result in NOx reductions, since thermal NOx is produced in the near field, but without the possibly harmful effects of pressure waves throughout the combustor.
DTIC
Gas Turbines; Injection; Oscillations; Combustion Chambers; Emission

19970004802 NASA Lewis Research Center, ClevelandOH USA
Propulsion Selection for 85kft Remotely Piloted Atmospheric Science Aircraft
Bents, David J., NASA Lewis Research Center, USA; Mockler, Ted, NASA Lewis Research Center, USA; Maldonado, Jaime, NASA Lewis Research Center, USA; Hahn, Andrew, NASA Ames Research Center, USA; Cyrus, John, Naval Air Warfare Center, USA; Schmitz, Paul, Power Computing Solutions, Inc., USA; Harp, Jim, Thermo Mechanical Systems Co., USA; King, Joseph, Thermo Mechanical Systems Co., USA; Oct. 1996; 20p; In English; AUVSI 1996, 16-19 Jul. 1996, Orlando, FL, USA; Sponsored by Association for Unmanned Vehicle Systems, USA
Contract(s)/Grant(s): RTOP 537-10-20
Report No.(s): NASA-TM-107302; NAS 1.15:107302; E-10390; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This paper describes how a 3 stage turbocharged gasoline engine was selected to power NASA's atmospheric science unmanned aircraft now under development. The airplane, whose purpose is to fly sampling instruments through targeted regions of the upper atmosphere at the exact location and time (season, time of day) where the most interesting chemistry is taking place, must have a round trip range exceeding 1000 km, carry a payload of about 500 lb to altitudes exceeding 80 kft over the site, and

be able to remain above that altitude for at least 30 minutes before returning to base. This is a subsonic aircraft (the aerodynamic heating and shock associated with supersonic flight could easily destroy the chemical species that are being sampled) and it must be constructed so it will operate out of small airfields at primitive remote sites worldwide, under varying climate and weather conditions. Finally it must be low cost, since less than $50 M is available for its development. These requirements put severe constraints on the aircraft design (for example, wing loading in the vicinity of 10 psf) and have in turn limited the propulsion choices to already-existing hardware, or limited adaptations of existing hardware. The only candidate that could emerge under these circumstances was a propeller driven aircraft powered by spark ignited (SI) gasoline engines, whose intake pressurization is accomplished by multiple stages of turbo-charging and intercooling. Fortunately the turbocharged SI powerplant, owing to its rich automotive heritage and earlier intensive aero powerplant development during WWII, enjoys in addition to its potentially low development costs some subtle physical advantages (arising from its near-stochiometric combustion) that may make it smaller and lighter than either a turbine engine or a diesel for these altitudes. Just as fortunately, the NASA/industry team developing this aircraft includes the same people who built multi-stage turbocharged SI powerplants for unmanned military spyplanes in the early 1980's. Now adapting hardware developed for reconaissance at 65-70 kft to the interests of atmospheric science at 80-90 kft, their efforts should yield an aero powerplant that pushes the altitude limits of subsonic air breathing propulsion.
Author
Air Breathing Engines; Subsonic Aircraft; Atmospheric Chemistry; Atmospheric Physics; Upper Atmosphere; Low Cost; Pilotless Aircraft; Aircraft Design; Aerodynamic Heating

19970005036 NASA Lewis Research Center, Cleveland, OH USA
Relative Performance Comparison Between Baseline Labyrinth and Dual-Brush Compressor Discharge Seats in a T-7OO Engine Test
Hendricks, Robert C., NASA Lewis Research Center, USA; Griffin, Thomas S., NASA Lewis Research Center, USA; Kline, Teresa R., NASA Lewis Research Center, USA; Csavina, Kristine R., NASA Lewis Research Center, USA; Pancholi, Arvind, General Electric Co., USA; Sood, Devendra, General Electric Co., USA; 1994; 24p; In English; 39th; Gas Turbine and Aeroengine Congress and Exposition, 13-16 Jun. 1994, The Hague, Netherlands; Sponsored by American Society of Mechanical Engineers, USA
Contract(s)/Grant(s): 1L162211A47A
Report No.(s): NASA-TM-106360; NAS 1.15:106360; AD-A313461; NASA-E-8154; ARL,XB-MR-232; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In separate series of YT-700 engine tests, direct comparisons were made between the forward-facing labyrinth and dual-brush compressor discharge seals. Compressor speeds to 43,000 rpm, surface speeds to 160 m/s (530 ft/s), pressures to 1 MPa (145 psi), and temperatures to 680 K(765 deg. F) characterized these test. The wear estimate for 46 hr of engine operations was less than 0.025 mm (0.001 in.) of the Haynes 25 alloy bristles running against a chromium-carbide-coated rub runner. The pressure drops were higher for the dual-brush seal than for the forward-facing labyrinth seal and leakage was lower-with the labyrinth seal leakage being 2% times greater-implying better seal characteristics, better secondary airflow distribution , and better engine performance (3 percent at high pressure to 5 percent at lower pressure) for the brush seal. (However, as brush seals wear down (after 500 to 1000 hr of engine operation), their leakage rates will increase.) Modification of the secondary flow path requires mat changes in cooling air and engine dynamics be accounted for.
DTIC
Air Flow; Engine Tests; Flow Distribution; Labyrinth Seals; Secondary Flow; Brush Seals; Chromium Carbides; Cyclic Loads

19970006983 NASA Lewis Research Center, Cleveland, OH USA
Endwall Heat Transfer Measurements in a Transonic Turbine Cascade
Giel, P. W., NYMA, Inc., USA; Thurman, D. R., Army Research Lab., USA; VanFossen, G. J., NASA Lewis Research Center, USA; Hippensteele, S. A., NASA Lewis Research Center, USA; Boyle, R. J., NASA Lewis Research Center, USA; Dec. 1996; 18p; In English; 41st; Gas Turbine and Aeroengine Congress, 10-13 Jun. 1996, Birmingham, UK; Sponsored by American Society of Mechanical Engineers, USA
Contract(s)/Grant(s): NAS3-27186; RTOP 523-26-13
Report No.(s): NASA-TM-107387; E-10583; NAS 1.15:107387; ARL-TR-1253; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Turbine blade endwall heat transfer measurements are given for a range of Reynolds and Mach numbers. Data were obtained for Reynolds numbers based on inlet conditions of 0.5 and 1.0 x 106, for isentropic exit Mach numbers of 1.0 and 1.3, and for freestream turbulence intensities of 0.25% and 7.0%. Tests were conducted in a linear cascade at the NASA Lewis Transonic Turbine Blade Cascade Facility. The test article was a turbine rotor with 136' of turning and an axial chord of 12.7 cm. The large scale allowed for very detailed measurements of both flow field and surface phenomena. The intent of the work is to provide benchmark

quality data for computational fluid dynamics (CFD) code and model verification. The flow field in the cascade is highly three-dimensional as a result of thick boundary layers at the test section inlet. Endwall heat transfer data were obtained using a steady-state liquid crystal technique.
Author
Heat Transfer; Turbine Blades; Turbulent Flow; Flow Distribution; Supersonic Turbines; Wall Flow; Cascade Wind Tunnels

19970006992 Toledo Univ., Dept. of Mechanical, Industrial and Manufacturing Engineering, OH USA
Advanced Models for Aeroelastic Analysis of Propulsion Systems ***Final Report, 16 Aug. 1989 - 9 Dec. 1993***
Keith, Theo G., Jr., Toledo Univ., USA; Mahajan, Aparajit, Toledo Univ., USA; Nov. 1996; 5p; In English
Contract(s)/Grant(s): NAG3-1068
Report No.(s): NASA-CR-202646; NAS 1.26:202646; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
This report describes an integrated, multidisciplinary simulation capability for aeroelastic analysis and optimization of advanced propulsion systems. This research is intended to improve engine development, acquisition, and maintenance costs. One of the proposed simulations is aeroelasticity of blades, cowls, and struts in an ultra-high bypass fan. These ducted fans are expected to have significant performance, fuel, and noise improvements over existing engines. An interface program was written to use modal information from COBSTAN and NASTRAN blade models in aeroelastic analysis with a single rotation ducted fan aerodynamic code.
Derived from text
Ducted Fans; Engine Design; Propulsion System Configurations; Aeroelasticity; Air Intakes; Finite Element Method

19970006994 NASA Lewis Research Center, Cleveland, OH USA
Forced Response Testing of an Axi-Centrifugal Turboshaft Engine
Owen, A. Karl, Army Research Lab., USA; Mattern, Duane L., NYMA, Inc., USA; Braun, Donald C., NASA Lewis Research Center, USA; Le, Dzu K., NASA Lewis Research Center, USA; Oct. 1996; 20p; In English; 32nd; Joint Propulsion Conference, 1-3 Jul. 1996, Lake Buena Vista, FL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS3-27186; RTOP 505-62-10
Report No.(s): NASA-TM-107337; E-10474; NAS 1.15:107337; ARL-TR-1151; AIAA Paper 96-2573; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Dynamic data from tests of a T55-L,712 engine are presented. Engine stall/surge data were analyzed using digital signal processing techniques. In addition, forced response testing (system identification studies) was done at various engine speeds. Forced response testing was done using eight jet ejectors approximately equally circumferentially spaced about the compressor front face. This paper presents some preliminary results for the ground idle (approximately 60% of design speed) point. Brief descriptions of the jet injection system, the test matrix, and analysis techniques used are presented. Results of these analyses indicate a substantial transfer of energy across the compressor first stage at some frequencies and that the ejectors are effective in modifying the local flow conditions in front of the first compressor stage.
Author
Turboshafts; Gas Turbine Engines; Fourier Analysis; Traveling Waves; Energy Transfer; Rotating Stalls; Turbocompressors; Frequency Distribution; Dynamic Response

08
AIRCRAFT STABILITY AND CONTROL

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

19970004646 NASA Dryden Flight Research Center, Edwards, CA USA
Evaluation of High-Angle-of-Attack Handling Qualities for the X-31A Using Standard Evaluation Maneuvers
Stoliker, Patrick C., NASA Dryden Flight Research Center, USA; Bosworth, John T., NASA Dryden Flight Research Center, USA; Sep. 1996; 36p; In English; High-Angle-of-Attack Technology, 17-19 Sep. 1996, Hampton, VA, Lisbon, USA, Portugal
Contract(s)/Grant(s): RTOP 505-68-30
Report No.(s): NASA-TM-104322; H-2128; NAS 1.15:104322; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The X-31A aircraft gross-acquisition and fine-tracking handling qualities have been evaluated using standard evaluation maneuvers developed by Wright Laboratory, Wright-Patterson Air Force Base. The emphasis of the testing is in the angle-of-attack range between 30 deg and 70 deg. Longitudinal gross-acquisition handling qualities results show borderline Level 1/Level 2 performance. Lateral gross-acquisition testing results in Level 1/Level 2 ratings below 45 deg angle of attack, degrading into Level

3 as angle of attack increases. The fine-tracking performance in both longitudinal and lateral axes also receives Level 1 ratings near 30 deg angle of attack, with the ratings tending towards Level 3 at angles of attack greater than 50 deg. These ratings do not match the expectations from the extensive close-in combat testing where the X-31A aircraft demonstrated fair to good handling qualities maneuvering for high angles of attack. This paper presents the results of the high-angle-of-attack handling qualities flight testing of the X-31A aircraft. Discussion of the preparation for the maneuvers, the pilot ratings, and selected pilot comments are included. Evaluation of the results is made in conjunction with existing Neal-Smith, bandwidth, Smith-Geddes, and military specifications.
Author
Angle of Attack; X-31 Aircraft; Flight Control; Pilot Induced Oscillation; Flight Tests; Aircraft Maneuvers; Aircraft Control

19970005048 NASA Langley Research Center, Hampton, VA USA
Three Dimensional Solution of Pneumatic Active Control of Forebody Vortex Asymmetry
Kandil, Osama A., Old Dominion Univ., USA; SharafEl-Din, Hazem H., Old Dominion Univ., USA; Liu, C. H., NASA Langley Research Center, USA; 1995; 13p; In English; 33rd; Aerospace Sciences, 9-12 Jan. 1995, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAG1-648
Report No.(s): NASA-CR-203089; NAS 1.26:203089; AIAA Paper 95-0101; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

Pneumatic active control of asymmetric vortical flows around a slender pointed forebody is investigated using the three dimensional solution for the compressible thin-layer Navier-Stokes equation. The computational applications cover the normal and tangential injection control of asymmetric flows around a 5 degree semi-apex angle cone at a 40 degree angle of attack, 1.4 freestream Mach number and 6 x 10(exp 6) freestream Reynolds number (based on the cone length). The effective tangential angle range of 67.5 approaches minus 67.5 degrees is used for both normal and tangential ports of injection. The effective axial length of injection is varied from 0.03 to 0.05. The computational solver uses the implicit, upwind, flux difference splitting finite volume scheme, and the grid consists of 161 x 55 x 65 points in the wrap around, normal and axial directions, respectively. The results show that tangential injection is more effective than normal injection.
Author
Angle of Attack; Finite Volume Method; Flux Difference Splitting; Forebodies; Navier-Stokes Equation; Pneumatic Control; Tangential Blowing

19970005147 NASA Langley Research Center, Hampton, VA USA
Ground-to-Flight Handling Qualities Comparisons for a High Performance Airplane
Brandon, Jay M., NASA Langley Research Center, USA; Glaab, Louis J., Lockheed Engineering and Sciences Co., USA; Brown, Philip W., NASA Langley Research Center, USA; Phillips, Michael R., NASA Langley Research Center, USA; 1995; 24p; In English; Atmospheric Flight Mechanics, 7-9 Aug. 1995, Baltimore, MD, USA
Report No.(s): NASA-TM-111925; NAS 1.15:111925; AIAA Paper 95-3457; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A flight test program was conducted in conjunction with a ground-based piloted simulation study to enable a comparison of handling qualities ratings for a variety of maneuvers between flight and simulation of a modern high performance airplane. Specific objectives included an evaluation of pilot-induced oscillation (PIO) tendencies and a determination of maneuver types which result in either good or poor ground-to-flight pilot handling qualities ratings. A General Dynamics F-16XL aircraft was used for the flight evaluations, and the NASA Langley Differential Maneuvering Simulator was employed for the ground based evaluations. Two NASA research pilots evaluated both the airplane and simulator characteristics using tasks developed in the simulator. Simulator and flight tests were all conducted within approximately a one month time frame. Maneuvers included numerous fine tracking evaluations at various angles of attack, load factors and speed ranges, gross acquisitions involving longitudinal and lateral maneuvering, roll angle captures, and an ILS task with a sidestep to landing. Overall results showed generally good correlation between ground and flight for PIO tendencies and general handling qualities comments. Differences in pilot technique used in simulator evaluations and effects of airplane accelerations and motions are illustrated.
Author
F-16 Aircraft; Research Aircraft; Ground Handling; Pilot Induced Oscillation; Flight Tests; Flight Simulation; Controllability; Lateral Control; Lateral Oscillation

09
RESEARCH AND SUPPORT FACILITIES (AIR)

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

19970006689 EA Engineering Science and Technology, Inc., Anchorage, AK USA
Tin City Long Range Radar Station, Alaska. Final Remedial Investigation/Feasibility Study, Volume 1 ***Final Report***
Apr. 30, 1996; 402p; In English; Limited Reproducibility: More than 20% of this document may be affected by poor print and microfiche quality
Contract(s)/Grant(s): F41624-94-D-8052
Report No.(s): AD-A308165; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

This Final Remedial Investigation/Feasibility Study describes the work performed; explains project objectives; and presents data collected during project activities, results, and conclusions for the Installation Restoration Program at Tin City Long Range Radar Station, Alaska. The report describes the risks posed by the site and gives the basis for selecting remedies to mitigate the risks.
DTIC
Feasibility; Installing

19970006960 Science Applications International Corp., Arlington, VA USA
Vertiport Characteristics ***Final Report***
Peisen, Deborah J., Science Applications International Corp., USA; Berardo, Stephen V., Hoyle, Tanner and Associates, USA; Ludders, J. R., Hoyle, Tanner and Associates, USA; Dyment, Richard J., Hoyle, Tanner and Associates, USA; Ferguson, Sam, EMA, USA; Jan. 1996; 213p; In English
Contract(s)/Grant(s): DTFA01-93-C-00030
Report No.(s): AD-A313609; DOT/FAA/RD-94/10; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

It is expected that large helicopters (such as the Westland Helicopters EH-101 and the Sikorsky S-92) and the Civil tTiltrotor (CIR) will become viable, important vehicles for the relief of both ground and airport congestion. As a consequence, the expanded use of vertical flight vehicles will result in scheduled passenger service. to prepare for this eventuality, the characteristics of large heliports and vertiports must be more precisely defined in terms of what will be required to best serve the passenger market. This report discusses the general physical requirements of large heliports and vertiport used for passenger service. It discusses the current design requirements and compares these to what would be required to accommodate large numbers of passengers. It discusses the experience gained in airport design and the contribution this experience can make to future vertiport design. Actual designs of vertiports are developed for five urban sites. The facility types and sites are: City Center, Ground Level - Union Terminal, Cincinnati, Ohio; City Center, Elevated - Greyhound Parking Garage, Phoenix, Arizona; Metro Station, Union Station, Washington, D.C.; Suburban - New Site, Mansfield, Texas; On-Airport - JFK International Airport, New York, New York. The report discusses problems encountered in developing these designs and presents the challenge of providing vertiports for urban passengers. The report also provides general costs for developing a vertiport at each location.
DTIC
Design Analysis; Airports; Helicopters; Requirements

19970007002 SAIC Ltd., Cambridge, UK
Heliport/Vertiport Implementation Process-Case Studies ***Final Report***
Peisen, Deborah J., SAIC Ltd., UK; Winick, Robert M., American Inst. of Certified Planners, USA; Berardo, Stephen V., Hoyle, Tanner and Associates, USA; Ludders, J. Richard, Hoyle, Tanner and Associates, USA; Ferguson, Samuel W., EMA, USA; Aug. 1996; 94p; In English; Helicopter Association International Convention, 1994, Anaheim,CA., USA
Contract(s)/Grant(s): DTFA01-93-C-00030
Report No.(s): DOT/FAA/ND-96/1; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Attempts to build public-use facilities have often failed, primarily at the local government level. On the other hand, a few public-use heliports and vertiports have been built and operated successfully. This raises the question of why some heliports are approved and built while others are rejected? The study attempts to provide some answers to that question and to identify more effective approaches to the public approval processes for vertical flight facilities. This study analyzes the approval process three ways. First, through the investigation of the nature of the public approval/implementation process that presents two approaches to heliport implementation. One is the systematic development of informed consent (SDIC), and the second is based on the results of a workshop held with persons experienced with heliport implementation. Next, six case studies of actual heliport approval pro-

cesses are presented to promote an understanding of critical elements and procedures significant in determining the success or failure of heliport/vertiport projects during the approval process. Case study locations are: Dallas TX, Portland ME, Pittsburgh PA, Washington DC, and San Francisco CA. The final section of the study provides information and offers strategies to assist heliport proposers in counteracting influences that often frustrate the implementation process.
Author
Heliports; Failure Analysis; Vertical Flight; Urban Development; Economic Development; Land Use; Public Relations

10
ASTRONAUTICS

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

19970005118 NASA Marshall Space Flight Center, Huntsville, AL USA
Experimental Investigation of Plume-Induced Flow Separation on the National Launch System 1 1/2-Stage Launch Vehicle
Springer, A., NASA Marshall Space Flight Center, USA; 1994; 12p; In English; 32nd; Aerospace Sciences, 10-13 Jan. 1994, Reno, NV, USA
Report No.(s): NASA-TM-112093; NAS 1.15:112093; AIAA Paper 94-0030; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

An experimental investigation of plume-induced flow separation on the National Launch System (NLS) 1 1/2-stage launch vehicle was done. This investigation resulted from concerns raised about the flow separation that was encountered on the Saturn 5. A large similarity exists between configurations and nominal trajectories. The study involved the use of solid plume simulators to simulate the base pressure encountered by the vehicle due to engine exhaust plumes at predetermined critical Mach numbers based on Saturn 5 flight plume effects. The solid plume was varied in location, resulting in a parametric study of base pressure effects on flow separation. In addition to the parametric study of arbitrary plume locations, the base pressure resulting from the nominal trajectory was tested. This analysis was accomplished through two wind tunnel tests run at NASA Marshall Space Flight Center's 14 x 14-inch Trisonic Wind Tunnel during 1992. The two tests were a static stability and a pressure test each using a 0.004-scale NLS 1 1/2-stage model. This study verified that flow separation is present at Mach 2.74 and 3.48 for predicted flight base pressures at nominal or higher levels. The flow separation at the predicted base pressure is only minor and should not be of great concern. It is not of the magnitude of the flow separation that was experienced on the Saturn 5. If the base pressure exceeds these nominal conditions, the flow separation can drastically increase, and is of concern.
Author
Separated Flow; Plumes; Simulators; Wind Tunnel Tests; Mach Number; Angle of Attack; Base Pressure

11
CHEMISTRY AND MATERIALS

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

19970004935 NASA Langley Research Center, Hampton, VA USA
Experimental Verification of a Progressive Damage Model for IM7/5260 Laminates Subjected to Tension-Tension Fatigue
Coats, Timothy W., Old Dominion Univ., USA; Harris, Charles E., NASA Langley Research Center, USA; Journal of Composite Materials; 1995; Volume 29, No. 3, pp. 280-305; In English
Report No.(s): NASA-TM-111921; NAS 1.15:111921; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The durability and damage tolerance of laminated composites are critical design considerations for airframe composite structures. Therefore, the ability to model damage initiation and growth and predict the life of laminated composites is necessary to achieve structurally efficient and economical designs. The purpose of this research is to experimentally verify the application of a continuum damage model to predict progressive damage development in a toughened material system. Damage due to monotonic and tension-tension fatigue was documented for IM7/5260 graphite/bismaleimide laminates. Crack density and delamination surface area were used to calculate matrix cracking and delamination internal state variables to predict stiffness loss in unnotched laminates. A damage dependent finite element code predicted the stiffness loss for notched laminates with good agreement to

experimental data. It was concluded that the continuum damage model can adequately predict matrix damage progression in notched and unnotched laminates as a function of loading history and laminate stacking sequence.
Author
Aircraft Structures; Finite Element Method; Resin Matrix Composites; Crack Propagation; Stiffness; Delaminating; Fiber Composites

19970005034 NASA Langley Research Center, Hampton, VA USA
Approximate Analysis for Interlaminar Stresses in Composite Structures with Thickness Discontinuities
Rose, Cheryl A., NASA Langley Research Center, USA; Starnes, James H., Jr., NASA Langley Research Center, USA; 1996; 18p; In English; 37th; Structures, Structural Dynamics, and Materials, 15-17 Apr. 1996, Salt Lake City, UT, USA; Sponsored by American Helicopter Society, Inc., USA
Report No.(s): NASA-TM-111888; NAS 1.15:111888; AIAA Paper 96-1497; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

An efficient, approximate analysis for calculating complete three-dimensional stress fields near regions of geometric discontinuities in laminated composite structures is presented. An approximate three-dimensional local analysis is used to determine the detailed local response due to far-field stresses obtained from a global two-dimensional analysis. The stress results from the global analysis are used as traction boundary conditions for the local analysis. A generalized plane deformation assumption is made in the local analysis to reduce the solution domain to two dimensions. This assumption allows out-of-plane deformation to occur. The local analysis is based on the principle of minimum complementary energy and uses statically admissible stress functions that have an assumed through-the-thickness distribution. Examples are presented to illustrate the accuracy and computational efficiency of the local analysis. Comparisons of the results of the present local analysis with the corresponding results obtained from a finite element analysis and from an elasticity solution are presented. These results indicate that the present local analysis predicts the stress field accurately. Computer execution-times are also presented. The demonstrated accuracy and computational efficiency of the analysis make it well suited for parametric and design studies.
Author
Interlaminar Stress; Composite Structures; Stress Distribution; Aircraft Structures; Structural Analysis; Stress Functions; Numerical Analysis

19970005063 Baylor Univ., Dept. of Aviation Sciences, Waco, TX USA
Proceedings of the First International Conference on Alternative Aviation Fuels *Final Report*
Hamilton, Jill, Baylor Univ., USA; May 1996; 297p; In English; 1st; International Conference on Alternate Aviation Fuels, 2-4 Nov. 1995, Waco, TX, USA
Report No.(s): AD-A313482; DOT/FAA/AR-96/42; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

Baylor University, in conjunction with the U.S. Department of Energy (DOE), Federal Aviation Administration (FAA), and Texas State Technical College presented the First International Conference on Alternative Aviation Fuels to introduce members of the industry to the promise and applications of alternative fuels in aviation. Topics covered in the papers and panels included: Environmental impact of alternative aviation fuels; Cost-effectiveness and characteristics of alternative fuels; Alternative aviation fuel case studies; Fuel suppliers' and manufacturers' responses to alternative fuels; Barriers to commercialization of the technology. The conference also included a Certification Procedure Workshop to provide insight into the process, procedures, and flight standards associated with alternative aviation fuels.
DTIC
Aircraft Fuels; Certification; Energy Policy; Environmental Surveys; Aircraft Industry; Standards

19970005173 Federal Aviation Administration, Airport and Aircraft Safety, Atlantic City, NJ USA
Characterization of an Oxygen/Nitrogen Permeable Membrane System *Final Report*
Abramowitz, Allen, Federal Aviation Administration, USA; Boris, Paul, Federal Aviation Administration, USA; Apr. 1996; 29p; In English
Report No.(s): AD-A308198; DOT/FAA/AR-95/91; AAR-423; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Federal Aviation Administration is investigating the use of alternate technologies for fire suppression aboard aircraft. A system was built using hollow fiber permeable selective membranes to separate air into its two major constituent gases, namely oxygen and nitrogen. System performance was characterized with regard to pressure, flow, temperature, and their affects on the nitrogen enriched stream. Test results indicate that nitrogen stream purity varies directly with air pressure and temperature and

inversely with flow rate. The test data also indicate that there is an optimum combination of flow and nitrogen purity for inerting a fixed volume.
DTIC
Fires; Membranes; Nitrogen; Oxygen; Aircraft Safety; Flow Velocity; Pressure Effects; Temperature Dependence

19970005373 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH USA
MMC Life System Development, Phase 1, A NASA/Pratt and Whitney Life Prediction Cooperative Program
Zaretsky, Erwin V., Editor, National Aeronautics and Space Administration. Lewis Research Center, USA; Nov. 1996; 146p; In English
Contract(s)/Grant(s): RTOP 505-63-5B
Report No.(s): NASA-RP-1361; NAS 1.61:1361; E-9479; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Metal-matrix composites (MMC's), typically consisting of a titanium alloy matrix and ceramic reinforcement, are generally held as leading candidate materials for tomorrow's aircraft engines. Recognizing this, NASA Lewis Research Center and Pratt and Whitney Division of United Technologies, Inc. entered into a four-year cooperative effort, hoping to lay the foundations of knowledge that will make these materials more reliable and ultimately less exotic. The four-year study which began in January 1988, had several objectives; assessing life and fracture prediction methods, determining the actual fracture strength and lives of 6-in. diameter MMC rings made from a titanium alloy designated SiC(SCS-6)Ti-15V-3Cr-3Al-3Sn; and evaluating different means of nondestructive evaluation (NDE). Chosen for its extensive data ase, this material represents the MMC's that would be used in an aircraft engine but is not the specific grade. Five separate fracture and life prediction analysis methods were applied and compared with each other and with fracture data of the rings Manufacturing defects inherent in the rings prevented the researchers from conducting planned cyclic tests. Fatigue predictions ranged from 1000 to 15,000 cycles. Fracture predictions were less scattered, ranging from 25 to 40.1 ksi. Low resolution x ray computed tomography proved an effective NDE evaluation tool. The results of the various studies, together with a material data base, are presented.
Author
Aircraft Engines; Engine Design; Fracture Strength; Metal Matrix Composites; Prediction Analysis Techniques; X Ray Analysis; Tomography; Life (Durability)

19970006819 Vanderbilt Univ., Dept. of Mechanical Engineering, Nashville, TN USA
Analysis of Fretting and Fretting Corrosion in Airframe Riveted Connections
Iyer, K., Vanderbilt Univ., USA; Xue, M., Vanderbilt Univ., USA; Bastias, P. C., Vanderbilt Univ., USA; Rubin, C. A., Vanderbilt Univ., USA; Hahn, G. T., Vanderbilt Univ., USA; Tribology for Aerospace Systems; Oct. 1996; 12p; In English; Also announced as 19970006808
Contract(s)/Grant(s): F49620-93-1-04888; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

This paper examines the contributions of fretting and fretting corrosion to the deterioration of one-rivet low lap joints under cyclic loading. Two- and three-dimensional, finite element models of the riveted lap joint are used to define the joint distortion and compliance and to evaluate the mechanical parameters that govern fretting wear and fretting fatigue including the local stresses, cyclic slip amplitudes and corresponding contact pressures at the rivet-panel and panel-panel interfaces. Effects of rivet geometry and plasticity are examined. A piezoelectric fretting wear machine is used to reproduce the relevant contact pressures and slip amplitudes and to measure fretting wear rates for uncoated 2024-T3 and 7075-T6 aluminum sheet in contact with hardened steel and aluminum in relativity dry, laboratory air and 3.5% saline solution. The effects of slip amplitudes in the range 5 to 35 microns on the specific wear rate and coefficient of friction have been evaluated. Predictions based on the results of the modeling and fretting wear and fretting fatigue criteria are compared with experimental observations of cyclically loaded riveted connections.
Author
Fretting; Airframes; Riveted Joints; Lap Joints; Wear; Aluminum Alloys; Coefficient of Friction; Three Dimensional Models; Fretting Corrosion

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ENGINEERING

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

19970004992 NASA Langley Research Center, Hampton, VA USA
Nonlinear Response and Residual Strength of Damaged Stiffened Shells Subjected to Combined Loads
Starnes, James H., Jr., NASA Langley Research Center, USA; Britt, Vicki O., NASA Langley Research Center, USA; Rose, Cheryl A., NASA Langley Research Center, USA; Rankin, Charles C., Lockheed Martin Palo Alto Research Lab., USA; 1996; 18p; In English; 37th; Structures, Structural Dynamics, and Materials, 15-17 Apr. 1996, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA-TM-111889; NAS 1.15:111889; AIAA Paper 96-1555; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

The results of an analytical study of the nonlinear response of stiffened fuselage shells with long cracks are presented. The shells are modeled with a hierarchical modeling strategy and analyzed with a nonlinear shell analysis code that maintains the shell in a nonlinear equilibrium state while the crack is grown. The analysis accurately accounts for global and local structural response phenomena. Fuselage skins, frames stringers and failsafe straps are included in the models. Results are presented for various combinations of internal pressure and mechanical bending, vertical shear and torsion loads, and the effects of crack orientation and location on the shell response are described. These results indicate that the nonlinear interaction between the in-plane stress resultants and the out-of-plane displacements near a crack can significantly affect the structural response of the shell, and the stress-intensity factors associated with a crack that are used to predict residual strength. The effects of representative combined loading conditions on the stress-intensity factors associated with a crack are presented. The effects of varying structural parameters on the stress-intensity factors associated with a crack, and on self-similar and non-self-similar crack-growth are also presented.
Author
Crack Propagation; Stress Intensity Factors; Fuselages; Shells (Structural Forms); Residual Strength; Reinforced Shells; Stress Distribution; Finite Element Method; Structural Analysis

19970005049 NASA Ames Research Center, Moffett Field, CA USA
Euler/Navier-Stokes Flow Computations on Flexible Configurations for Stability Analysis
Guruswamy, Guru P., NASA Ames Research Center, USA; Tu, Eugene L., NASA Ames Research Center, USA; 1995; 10p; In English; 36th; Structures, Structural Dynamics and Materials, 10-12 Apr. 1995, New Orleans, LA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA-TM-111930; NAS 1.15:111930; AIAA Paper 95-1292; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A01, Microfiche

Abstract Longitudinal dynamic stability derivatives required for design of aircraft are computed by using the state-of-the-art numerical methods for wing-body configurations. The flow is modeled using the Euler/Navier-Stokes equations with turbulence models and solved using an efficient finite-difference scheme suitable for patched structured grids. Computations are made at a flow regime that is beyond the limits of the current linear methods mostly used for computing stability derivatives. Flow conditions include shock-waves and viscous dominated vortical flows. Effect of Mach number and angle-of-attack on stability derivatives are demonstrated for a typical wing-body configuration. For the same configuration the effects of wing flexibility on the magnitude and phase angles of stability derivatives are also demonstrated.
Author
Computational Fluid Dynamics; Navier-Stokes Equation; Structured Grids (Mathematics); Finite Difference Theory; Stability Derivatives; Angle of Attack; Turbulence Models; Longitudinal Stability; Aerodynamic Stability; Mach Number

19970005140 Old Dominion Univ., Research Foundation, Hampton, VA USA
Prediction and Control of Vortex Dominated and Vortex-wake Flows ***Final Report, 1 Dec. 1993 - 1 Dec. 1995***
Kandil, Osama, Old Dominion Univ., USA; Feb. 1996; 5p; In English
Contract(s)/Grant(s): NAG1-994
Report No.(s): NASA-CR-202815; NAS 1.26:202815; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This report describes the activities and accomplishments under this research grant, including a list of publications and dissertations, produced in the field of prediction and control of vortex dominated and vortex wake flows.
Derived from text
Vortices; Active Control; Predictions; Turbulent Flow; Turbulent Wakes; Aircraft Wakes

19970005336 NASA Dryden Flight Research Center, Edwards, CA USA
Thermal and Mechanical Buckling Analysis of Hypersonic Aircraft Hat-Stiffened Panels With Varying Face Sheet Geometry and Fiber Orientation
Ko, William L., NASA Dryden Flight Research Center, USA; Dec. 1996; 37p; In English
Contract(s)/Grant(s): RTOP 505-63-50
Report No.(s): NASA-TM-4770; H-2097; NAS 1.15:4770; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Mechanical and thermal buckling behavior of monolithic and metal-matrix composite hat-stiffened panels were investigated. The panels have three types of face-sheet geometry: Flat face sheet, microdented face sheet, and microbulged face sheet. The metal-matrix composite panels have three types of face-sheet layups, each of which is combined with various types of hat composite layups. Finite-element method was used in the eigenvalue extractions for both mechanical and thermal buckling. The thermal buckling analysis required both eigenvalue and material property iterations. Graphical methods of the dual iterations are shown. The mechanical and thermal buckling strengths of the hat-stiffened panels with different face-sheet geometry are compared. It was found that by just microdenting or microbulging of the face sheet, the axial, shear, and thermal buckling strengths of both types of hat-stiffened panels could be enhanced considerably. This effect is more conspicuous for the monolithic panels. For the metal-matrix composite panels, the effect of fiber orientations on the panel buckling strengths was investigated in great detail, and various composite layup combinations offering, high panel buckling strengths are presented. The axial buckling strength of the metal-matrix panel was sensitive to the change of hat fiber orientation. However, the lateral, shear, and thermal buckling strengths were insensitive to the change of hat fiber orientation.
Author
Aircraft Structures; Panels; Thermal Buckling; Mechanical Properties; Finite Element Method; Hypersonic Aircraft; Fiber Orientation

19970005361 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA USA
Development of Metallic Thermal Protection Systems for the Reusable Launch Vehicle
Blosser, Max L., National Aeronautics and Space Administration. Langley Research Center, USA; Oct. 1996; 24p; In English; Space Technology and Applications International Forum, 26-30 Jan. 1997, Albuquerque, NM, USA
Contract(s)/Grant(s): RTOP 242-20-02-01
Report No.(s): NASA-TM-110296; NAS 1.15:110296; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
A reusable Thermal Protection System (TPS) that is not only lightweight, but durable, operable and cost effective is one of the technologies required by the Reusable Launch Vehicle (RLV) to achieve the goal of drastically reducing the cost of delivering payload to orbit. Metallic TPS is one of the systems being developed to meet this challenge. Current efforts involve improving the superalloy honeycomb TPS concept, which consists of a foil-gage metallic box encapsulating a low density fibrous insulation, and evaluating it for RLV requirements. The superalloy honeycomb TPS concept is mechanically attached to the vehicle structure. Improvements include more efficient internal insulation, a simpler, lighter weight configuration, and a quick-release fastener system for easier installation and removal. Evaluation includes thermal and structural analysis, fabrication and testing of both coupons and TPS panels under conditions simulating RLV environments. Coupons of metallic honeycomb sandwich, representative of the outer TPS surface, were subjected to low speed impact, hypervelocity impact, and rain erosion testing as well as subsequent arcjet exposure. Arrays of TPS panels have been subjected to radiant heating in a thermal/vacuum facility, aerodynamic heating in an arcjet facility and acoustic loading.
Author
Thermal Protection; Structural Analysis; Reusable Launch Vehicles; Measuring Instruments; Payloads; Loads (Forces); Hypervelocity Impact; Honeycomb Structures; Heat Resistant Alloys; Aerodynamic Heating; Acoustic Fatigue

19970005727
Numerical analysis of sweep effects in shrouded propfan rotors
Helming, K., German Aerospace Research Establishment, Germany; Journal of Propulsion and Power; January 1996; ISSN 0748-4658; 12, 1, pp. 139-145; In English; Copyright; Avail: Issuing Activity
to study blade sweep effects on loss production and energy transfer a numerical analysis has been undertaken on three 10-bladed fan rotors with low-pressure ratio and different sweep. Pressure ratio and sweep are in the typical range of propfans.

The results of two rotors with 30-deg forward- and backward-swept blades are compared to those of an unswept propfan rotor. The geometry of the profiles of the swept rotors on each cylindrical position is identical with that of the unswept rotor. The numerical analysis shows that the total pressure ratio of the swept rotors is lower than that of the unswept rotor over the whole span. Only in the vicinity of the hub is the pressure ratio higher in the case of the forward-swept rotor. The decrease of the total pressure ratio at midspan, by sweeping the rotor, is due to an oblique shock with lower preshock Mach number and an increase of the boundary layer at the suction side. Sweeping the rotor has the effect to induce strong radial pressure gradients at the leading edge. The deflection of the flow towards and off the end-walls due to this pressure gradient has the effect of a changed diffusion and expansion of the flow in the vicinity of the end-walls. The emphasis of this article is not to directly provide rotors with better pressure ratios and efficiencies, but to explain the basic effects by sweeping fan-rotors as references for improving the rotor-aerodynamic.
Author (EI)
Energy Transfer; Mach Number; Numerical Analysis; Pressure; Pressure Ratio; Prop-Fan Technology; Propeller Fans; Rotors; Sweep Effect; Turbomachine Blades

19970006772 Auburn Univ., Dept. of Mechanical Engineering, AL USA
Steady-State Dynamic Behavior of a Flexible Rotor With Auxiliary Support From a Clearance Bearing
Xie, Huajun, Auburn Univ., USA; Flowers, George T., Auburn Univ., USA; Feng, Li, Auburn Univ., USA; Lawrence, Charles T., NASA Lewis Research Center, USA; Influence of Back-up Bearings and Support Structure Dynamics on the Behavior of Rotors With Active Supports; Oct. 1996; 22p; In English; Also announced as 19970006770; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper investigates the steady-state responses of a rotor system supported by auxiliary bearings in which there is a clearance between the rotor and the inner race of the bearing. A simulation model based upon the rotor of a production jet engine is developed and its steady-state behavior is explored over a wide range of operating conditions for various parametric configurations. Specifically, the influence of rotor imbalance, clearance, support stiffness and damping is studied. Bifurcation diagrams are used as a tool to examine the dynamic behavior of this system as a function of the afore mentioned parameters. The harmonic balance method is also employed for synchronous response cases. The observed dynamical responses is discussed and some insights into the behavior of such systems are presented.
Author
Steady State; Dynamic Characteristics; Rotors; Bearings

19970006808 Advisory Group for Aerospace Research and Development, Structures and Materials Panel, Neuilly-Sur-Seine, France
Tribology for Aerospace Systems ***La Tribologie pour les Systemes Aerospatiaux***
Tribology for Aerospace Systems; Oct. 1996; 128p; In English; In French; 82d, 6-7 May 1996, Sesimbra, Portugal; Sponsored by Advisory Group for Aerospace Research and Development, France; Also announced as 19970006809 through 19970006825
Report No.(s): AGARD-CP-589; ISBN-92-836-0029-0; Copyright Waived; Avail: CASI; A07, Hardcopy; A02, Microfiche

Fretting and wear of hinges, tracks, bearings, and gearboxes in airframes and engines is a constant problem for aircraft or other defense systems, as they induce failures and jamming, necessitating costly in-service inspections and replacement of parts. At the 82nd Meeting of the AGARD Structures and Materials Panel a Specialist's Meeting was held on Tribology for Aerospace Systems. The meeting was split into three sessions (18 papers): (1) new technologies such as coatings, new materials, lubrication and their behavior; (2) practical applications in airframes and their mechanical systems; and (3) practical applications to engines, both jet engines and reciprocal engines. The meeting was ended by a round table discussion.
Author
Aerospace Systems; Tribology; Lubrication; Airframes; Jet Engines; Wear Resistance; Engine Parts; Wear Inhibitors; Conferences

19970006820 Porto Univ., Faculdade de Engenharia, Portugal
EHD Analysis of a Roller/Inner Ring Contact in a Jet Engine Roller Bearing
Seabra, J., Porto Univ., Portugal; Campos, A., Porto Univ., Portugal; Tribology for Aerospace Systems; Oct. 1996; 12p; In English; Also announced as 19970006808
Contract(s)/Grant(s): Aero-0007-A(c); Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

This paper deals with the analysis of an EHD (elastohydrodynamic) roller/inner ring contact in a roller bearing for a jet engine application. The equations for the EHD lubrication problem, with longitudinal roughness, and their numerical solution for a Newtonian fluid are presented. A typical geometry of a jet engine roller bearing is studied in detail, both in terms of lubricant film thickness and of elastic deformation of the roller. The results obtained show that the geometry of the roller in the transverse direc-

tion, produces a contact area of particular shape, avoiding the appearance of significant edge over-pressures, independently of the operating conditions. The influence of the load and rolling speed on the film thickness, both for smooth and wavy surfaces, was also investigated. The results obtained support the conclusion that the surface waviness considered produce a small decrease of the film thickness, when compared with the smooth case, and that the elastic deformation of the waviness is strongly dependent on the rolling speed. Finally a correlation of the EHD film thickness results for the the roller/inner ring contact is obtained and compared with known solutions.
Author
Elastohydrodynamics; Roller Bearings; Jet Engines; Engine Parts; Lubrication; Mathematical Models

19970006822 Turbomeca S.A. - Brevets Szydlowski, Bordes, France
The Reliability of the Bearings of Small and Medium Turbines Being More and More Dependent on Tribology ***La fiabilite des roulements des petites et moyennes turbines de plus en plus de'pendante de la tribologie***
Paty, Gerard, Turbomeca S.A. - Brevets Szydlowski, France; Cheftel, Brigitte, Turbomeca S.A. - Brevets Szydlowski, France; Tribology for Aerospace Systems; Oct. 1996; 10p; In French; Also announced as 19970006808; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Bearings reliability in the mechanical industry was in the past very dependent on material fatigue. Because of their high speed, aeronautical applications added high friction conditions and then generated more surface damages. The important progress made with steel quality, particularly with vacuum elaborated types used in aeronautics now prevent most of the classical deep initiated fatigue failures. Defect initiation moved toward the contact surface which therefore becomes the research and development center of interest of the future. The high speed bearings are lubricated in the most effective manner. The creation of an oil film which separates the surfaces is essential to avoid metal to metal contact. New computer codes such as BEDALES and QUASAR, developed with the support of the European Community during the last years, led to a better understanding and prediction of this behavior. Nevertheless turbine engines continue to suffer defects whose initiations are often linked with tribological weaknesses. Skidding is one of the most important. It depends widely on material surface temperature capacity. Pollution of oil systems with hard particles is another source currently being investigated in terms of damage tolerance. Bearing cages also have to withstand severe contact conditions which overlap the capacity of the current technology. Surface and subsurface stresses have an essential role in the control of the fatigue failure initiation and development. The investigations on a set of used bearings with new NDT techniques as Barkhausen noise show promising information for developing new tools in this area.
Author (revised)
Bearings; Gas Turbine Engines; Tribology; Wear; Lubrication; Engine Parts

19970006823 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany
Airseals for Advanced Military Jet Engines
Uihlein, T. J., Motoren- und Turbinen-Union G.m.b.H., Germany; Tribology for Aerospace Systems; Oct. 1996; 20p; In English; Also announced as 19970006808; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

In advanced military jet engines airseals represent one of the most challenging key technologies. Without properly functioning seal systems it is not possible to attain the high pressure ratios needed for high efficiencies and low specific fuel consumption. Moreover a poorly functioning seal system can result in blade losses and titanium fire, or in heavy damage to the rotor in the case of labyrinth seals, which is even more dangerous. to overcome these problems a basic understanding of the wear mechanisms of the different seal systems is necessary. This requires rub testing under simulated engine conditions to determine the limitations of each system. Only with this knowledge can the design and improvement of abradables, fin coatings or tip coatings be successful. Apart from abradability this optimization also includes, for example, erosion resistance, high cycle fatigue strength of tip coated blades, or damage tolerance of abradables against blade passing frequencies.
Author (revised)
Seals (Stoppers); Jet Engines; Wear; Engine Parts

19970007016 Toledo Univ., Dept. of Mechanical, Industrial and Manufacturing Engineering, OH USA
Aeroelastic Analysis of Turbomachinery for Space Propulsion ***Final Report, 13 Jan. 1993 - 23 Feb. 1996***
Keith, Theo G., Jr., Toledo Univ., USA; Murthy, Durbha V., Toledo Univ., USA; Nov. 1996; 10p; In English
Contract(s)/Grant(s): NAG3-1449
Report No.(s): NASA-CR-202643; NAS 1.15:202643; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The purpose of this report is to provide a description of the overall thrust, past relevant accomplishments and future work for research that was performed on the titled project. The purpose of this work was to perform applied research at the NASA Lewis

Research Center in the area of the aeroelastic behavior of turbomachinery used in air-breathing propulsion. This activity was undertaken in close cooperation with the Structural Dynamics Branch of the Structures Division at NASA Lewis.
Author
Aeroelasticity; Turbomachinery; Propulsion; Thrust; Flutter

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GEOSCIENCES

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

19970005019 NASA Langley Research Center, Hampton, VA USA
Utilizing GPS to Determine Ionospheric Delay over the Ocean
Katzberg, Stephen J., NASA Langley Research Center, USA; Garrison, James L., Jr., NASA Langley Research Center, USA; Dec. 1996; 18p; In English
Contract(s)/Grant(s): RTOP 225-99-00-01
Report No.(s): NASA-TM-4750; NAS 1.15:4750; L-7575; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Several spaceborne altimeters have been built and flown, and others are being developed to provide measurements of ocean and ice sheet topography. Until the launch of TOPEX, altimeters were single frequency systems incapable of removing the effects of ionospheric delay on the radar pulse. With the current state of the art in satellite altimetry, the ionosphere causes the largest single error when using single frequency altimeters. Ionospheric models provide the only recourse short of adding a second frequency to the altimeter. Unfortunately, measurements of the ionosphere are lacking over the oceans or ice sheets where they are most needed. A possible solution to the lack of data density may result from an expanded use of the Global Positioning System (GPS). This paper discusses how the reflection of the GPS signal from the ocean can be used to extend ionospheric measurements by simply adding a GPS receiver and downward-pointing antenna to satellites carrying single frequency altimeters. This paper presents results of a study assessing the feasibility and effectiveness of adding a GPS receiver and downward-pointing antenna to satellites carrying single frequency altimeters.
Author
Altimeters; Global Positioning System; Spaceborne Experiments; Earth Ionosphere; Atmospheric Models; Satellite Altimetry; Sea Ice

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LIFE SCIENCES

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

19970005130 Prime Technology, Inc., Dayton, OH USA
Aviation Epidemiology Data Register ***Final Report, 1 Mar. 1992 - 7 Jun. 1996***
Saini, Surinder K., Prime Technology, Inc., USA; Aug. 1996; 21p; In English
Contract(s)/Grant(s): DAMD17-92-C-2062
Report No.(s): AD-A313749; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The two fundamental objectives of this contract were Data entry of all Flying Duty Medical Examination (FDME) and analytical support and research data retrieval for clinical assessment purposes. Each FDME was entered into the backlog file and a print out of all prior medical history was generated. All medical history was given a lCD9CM code After all medical history has been coded and an AEDR file established other medical information is transcribed into the AEDR from the FDME. There are approximately 172 fields in the AEDR for administrative and medical testing results. Utilizing the 40-501, various APLs, and the Flight Surgeons guide, each FDME is then pre-reviewed, or screened for medical conditions which are out of standards and any medical conditions which may require special action by the Aeromedical Activity Screeners A recommendation is then written on the accompanying computer generated cover sheet The entire packet is then forwarded to the Aeromedical Activity flight surgeon for Review and Disposition. As an ongoing process, contract personnel sought ways to promote the quick turnaround of FDMEs without losing quality assurance. Also searched for was a quick and accurate way to track an FDME and eliminate repetitive time use for the flight surgeon in the field, while at the same time making available to him information concerning the air crewmember he would be examining. Each year aviators and aviation related personnel are required to take a Flight Duty Medical Examination.

One requirement of the annual FDME was to complete a Standard Form 93 medical history form. Due to the tremendous number of FDMES processed annually through the Aeromedical Activity, it became necessary to develop a process by which a EDME could be located quickly.
DTIC
Data Retrieval; Data Bases; Data Processing; Aerospace Medicine; Aircraft Pilots; Epidemiology

19970005088 Armstrong Lab., Crew Systems Directorate, Wright-Patterson AFB, OH USA
Biodynamic and Spasticity Reduction in Joystick Control Via Force Reflection ***Final Report, Mar. 1992 - Sep. 1995***
Repperger, Daniel W., Armstrong Lab., USA; Sep. 1995; 31p; In English
Contract(s)/Grant(s): AF Proj. 7231
Report No.(s): AD-A313739; AL/CF-TR-1995-0152; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

When pilots are subjected to exogonous environmental influences such as complex acceleration fields during unusual aircraft maneuvers, these effects disturb the normal motion of the human body producing undesired biodynamic effects. These disturbances, in turn, affect how the pilot controls his aircraft. Thus, it becomes a problem of interest to investigate joystick controllers that show some resistance to these untoward effects. Force reflection algorithms, when applied to a joystick controller are shown to mitigate these unwanted motions induced by the environment. These same results also extrapolate to the problem involving the neuromotor disabled patients who suffer from spasticity. The disturbance in this case is internal, not external, but force reflecting stick controllers are shown to reduce these undesired responses. Data are given from pilots involving the external disturbances such as complex acceleration fields as well as for neuromotor disabled patients where disturbances are internally generated. Some general rules for applying these force reflection scenarios are given.
DTIC
Aircraft Maneuvers; Controllers; Biodynamics; Human Factors Engineering

19970005109 Villanova Univ., Dept. of Mechanical Engineering, PA USA
Modeling of a Deformable Manikin Neck for Multibody Dynamic Simulation ***Final Report, May 1994 - Oct. 1995***
Ashrafiuon, Hashem, Villanova Univ., USA; Colbert, Robert, Villanova Univ., USA; Obergefell, Louise, Armstrong Lab., USA; Kaleps, Ints, Armstrong Lab., USA; Oct. 1995; 32p; In English
Contract(s)/Grant(s): AF Proj. 2304
Report No.(s): AD-A313744; AL/CF-TR-1996-0087; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Articulated Total Body (ATE) is a rigid body dynamics computer model of the human body used at the Armstrong Laboratory (AL). The model is used to predict the kinetic response of the human body in different dynamic environments such as aircraft pilot ejections, sled tests, etc. In order to predict the response accurately, however, a rigid body dynamics model may not be sufficient. This is particularly true for the more flexible segments such as the neck and for cases where local segment vibrations occur. In this study, a deformable body dynamics option of the ATB is developed which incorporates linear deformation of individual segments in the ATB model. The displacements due to deformation are determined using finite element modal analysis. The study concentrates on the modeling of manikin necks which have shown large deformation in certain environments. The Hybrid 3 manikin neck finite element model and modal solution are presented. Modal analysis results are incorporated into the ATB model. Selected parameters for quasi-static Hybrid 3 neck and several head-neck dynamic simulations are compared with the experimental results where available. It is shown that the new model simulation results have excellent agreement with the experimental results particularly when compared with the rigid model.
DTIC
Computerized Simulation; Finite Element Method; Aircraft Pilots; Human Body

19970005366 Advisory Group for Aerospace Research and Development, Aerospace Medical Panel, Working Group 21, Neuilly-Sur-Seine, France
Anthropomorphic Dummies for Crash and Escape System Testing
Jul. 1996; 118p; In English; In French
Report No.(s): AD-A313660; AGARD-AR-330; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Anthropomorphic dummies are mechanical surrogates of the human body. Dummies are also called Anthropomorphic Test Devices (ATDs) and manikins. They are used as test devices by the automotive and aircraft industries and regulatory bodies, and the military to evaluate vehicle safety in crash and escape system environments. Dummies are designed to perform two basic functions. Earlier versions were used strictly for loading the vehicle dynamically, and required only weight and size in their design.

The second type of dummy, used to assess type and severity of injury, is designed to mimic human dynamic impact response. These dummies require a sensor suite of instrumentation to measure impact loading of different body parts to assess injury risk.
DTIC
Human Factors Engineering; Ejection Seats; Injuries; Escape Systems

19970005476 Santa Clara Univ., Dept. of Mechanical Engineering, ,CA USA
Machine-Vision Aids for Improved Flight Operations ***Final Report, Jan. 1994 - Oct. 1996***
Menon, P. K., Santa Clara Univ., USA; Chatterji, Gano B., Santa Clara Univ., USA; Nov. 1996; 235p; In English
Contract(s)/Grant(s): NCC2-841
Report No.(s): NASA-CR-202564; NAS 1.26:202564; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The development of machine vision based pilot aids to help reduce night approach and landing accidents is explored. The techniques developed are motivated by the desire to use the available information sources for navigation such as the airport lighting layout, attitude sensors and Global Positioning System to derive more precise aircraft position and orientation information. The fact that airport lighting geometry is known and that images of airport lighting can be acquired by the camera, has lead to the synthesis of machine vision based algorithms for runway relative aircraft position and orientation estimation. The main contribution of this research is the synthesis of seven navigation algorithms based on two broad families of solutions. The first family of solution methods consists of techniques that reconstruct the airport lighting layout from the camera image and then estimate the aircraft position components by comparing the reconstructed lighting layout geometry with the known model of the airport lighting layout geometry. The second family of methods comprises techniques that synthesize the image of the airport lighting layout using a camera model and estimate the aircraft position and orientation by comparing this image with the actual image of the airport lighting acquired by the camera. Algorithms 1 through 4 belong to the first family of solutions while Algorithms 5 through 7 belong to the second family of solutions. Algorithms 1 and 2 are parameter optimization methods, Algorithms 3 and 4 are feature correspondence methods and Algorithms 5 through 7 are Kalman filter centered algorithms. Results of computer simulation are presented to demonstrate the performance of all the seven algorithms developed.
Author
Computer Vision; Airport Lights; Navigation Aids; Landing Aids; Aircraft Landing; Air Navigation

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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.

19970005353 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA USA
User's Guide for Flight Simulation Data Visualization Workstation
Kaplan, Joseph A., National Aeronautics and Space Administration. Langley Research Center, USA; Chen, Ronnie, National Aeronautics and Space Administration. Langley Research Center, USA; Kenney, Patrick S., Unisys Corp., USA; Koval, Christopher M., Unisys Corp., USA; Hutchinson, Brian K., Unisys Corp., USA; Nov. 1996; 22p; In English
Report No.(s): NASA-TM-110294; NAS 1.15:110294; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Today's modern flight simulation research produces vast amounts of time sensitive data. The meaning of this data can be difficult to assess while in its raw format. Therefore, a method of breaking the data down and presenting it to the user in a graphical format is necessary. Simulation Graphics (SimGraph) is intended as a data visualization software package that will incorporate simulation data into a variety of animated graphical displays for easy interpretation by the simulation researcher. This document is intended as an end user's guide.
Author
Applications Programs (Computers); Flight Simulation; Software Development Tools; Software Engineering; Scientific Visualization; Display Devices; User Manuals (Computer Programs)

16
PHYSICS

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

19970004793 NASA Langley Research Center, Hampton, VA USA
The Influences of Lamination Angles on the Interior Noise Levels of an Aircraft
Fernholz, Christian M., George Washington Univ., USA; Robinson, Jay H., NASA Langley Research Center, USA; Aug. 1996; 90p; In English
Contract(s)/Grant(s): NCC1-14; RTOP 538-03-14-01
Report No.(s): NASA-TM-110250; NAS 1.15:110250; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The feasibility of reducing the interior noise levels of an aircraft passenger cabin through optimization of the composite lay up of the fuselage is investigated. MSC/NASTRAN, a commercially available finite element code, is used to perform the dynamic analysis and subsequent optimization of the fuselage. The numerical calculation of sensitivity of acoustic pressure to lamination angle is verified using a simple thin, cylindrical shell with point force excitations as noise sources. The thin shell used represents a geometry similar to the fuselage and analytic solutions are available for the cylindrical thin shell equations of motion. Optimization of lamination angle for the reduction of interior noise is performed using a finite element model of an actual aircraft fuselage. The aircraft modeled for this study is the Beech Starship. Point forces simulate the structure borne noise produced by the engines and are applied to the fuselage at the wing mounting locations. These forces are the noise source for the optimization problem. The acoustic pressure response is reduced at a number of points in the fuselage and over a number of frequencies. The objective function is minimized with the constraint that it be larger than the maximum sound pressure level at the response points in the passenger cabin for all excitation frequencies in the range of interest. Results from the study of the fuselage model indicate that a reduction in interior noise levels is possible over a finite frequency range through optimal configuration of the lamination angles in the fuselage. Noise reductions of roughly 4 dB were attained. For frequencies outside the optimization range, the acoustic pressure response may increase after optimization. The effects of changing lamination angle on the overall structural integrity of the airframe are not considered in this study.
Author
Aircraft Production; Cylindrical Shells; Equations of Motion; Finite Element Method; Frequency Ranges; Thin Walled Shells; Structural Design Criteria; Noise Reduction; Noise Intensity; Laminates

19970005047 General Electric Co., Aircraft Engines, Cincinnati, OH USA
Improved NASA-ANOPP Noise Prediction Computer Code for Advanced Subsonic Propulsion Systems, Volume 2, Fan Suppression Model Development ***Final Report***
Kontos, Karen B., General Electric Co., USA; Kraft, Robert E., General Electric Co., USA; Gliebe, Philip R., General Electric Co., USA; Dec. 1996; 80p; In English
Contract(s)/Grant(s): NAS3-26617; RTOP 538-08-11
Report No.(s): NASA-CR-202309; NAS 1.26:202309; E-10595; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Aircraft Noise Predication Program (ANOPP) is an industry-wide tool used to predict turbofan engine flyover noise in system noise optimization studies. Its goal is to provide the best currently available methods for source noise prediction. As part of a program to improve the Heidmann fan noise model, models for fan inlet and fan exhaust noise suppression estimation that are based on simple engine and acoustic geometry inputs have been developed. The models can be used to predict sound power level suppression and sound pressure level suppression at a position specified relative to the engine inlet.
Author
Aerodynamic Noise; Aircraft Noise; Noise Reduction; Noise Prediction; Pressure Reduction; Engine Inlets; Engine Noise

19970005327 Analytical Services and Materials, Inc., Hampton, VA USA
On the Coupling Between a Supersonic Turbulent Boundary Layer and a Flexible Structure ***Final Report***
Frendi, Abdelkader, Analytical Services and Materials, Inc., USA; Oct. 1996; 44p; In English
Contract(s)/Grant(s): NAS1-19700; RTOP 537-06-37-20
Report No.(s): NASA-CR-201631; NAS 1.26:201631; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A mathematical model and a computer code have been developed to fully couple the vibration of an aircraft fuselage panel to the surrounding flow field, turbulent boundary layer and acoustic fluid. The turbulent boundary layer model is derived using a triple decomposition of the flow variables and applying a conditional averaging to the resulting equations. Linearized panel and acoustic equations are used. Results from this model are in good agreement with existing experimental and numerical data. It is

shown that in the supersonic regime, full coupling of the flexible panel leads to lower response and radiation from the panel. This is believed to be due to an increase in acoustic damping on the panel in this regime. Increasing the Mach number increases the acoustic damping, which is in agreement with earlier work.
Author
Absorbers (Materials); Aircraft Structures; Computer Programs; Flexible Bodies; Mach Number; Mathematical Models; Turbulent Boundary Layer; Supersonic Boundary Layers

19970005394 NASA Langley Research Center, Hampton, VA USA
Nozzle Thrust Optimization While Reducing Jet Noise
Seiner, J. M., NASA Langley Research Center, USA; Gilinsky, M. M., NASA Langley Research Center, USA; 1995; 30p; In English; 1st; Joint CEAS/AIAA Aeroacoustics Conference, 12-15 Jun. 1995, Munich, Germany, 16th AIAA Aeroacoustics Conference; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): NASA-TM-111927; NAS 1.15:111927; CEAS/AIAA-95-149; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Bluebell nozzle design concept is proposed for jet noise reduction with minimal thrust loss or even thrust augmentation. A Bluebell nozzle has a sinusoidal lip line edge (chevrons) and a sinusoidal cross section shape with linear amplitude increasing downstream in the divergent nozzle part (corrugations). The experimental tests of several Bluebell nozzle designs have shown nose reduction relative to a convergent-divergent round nozzle with design exhaust number M(e) = 1.5. The best design provides an acoustic benefit near 4dB with about 1 percent thrust augmentation. For subsonic flow ((M(e)= 0.6)), the tests indicated that the present method for design of Bluebell nozzles gives less acoustic benefit and in most cases jet noise increased. The proposed designs incorporate analytical theory and 2D and 3D numerical simulations. Full Navier-Stokes and Euler solvers were utilized. Boundary layer effects were used. Several different designs were accounted for in the Euler applications.
Author
Noise Reduction; Nozzle Design; Thrust Augmentation; Aeroacoustics; Convergent-Divergent Nozzles; Jet Aircraft Noise

19970005466 Army Research Lab., Weapons Technology Directorate, Aberdeen Proving Ground, MD USA
In-Flight Projectile Imaging by Infrared Emission/Rotating Mirror Technique With Temperature Calibration *Final Report*
Stumpfel, Charles R., Army Research Lab., USA; Jul. 1996; 99p; In English
Contract(s)/Grant(s): 1L162618AH80
Report No.(s): AD-A313428; ARL-TR-1148; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

Many projectiles experience considerable heating which begins with the launch process in the gun and continues with aerodynamic heating throughout the flight. The high temperatures that result cause the surface to emit considerable infrared radiation. In this work, a rotating mirror system was applied to image projectiles by infrared emission. Factors that affect this system's image quality are identified and described. In addition to imaging, infrared emission may also be used to measure the surface temperatures of projectile components. A technique was developed to calibrate the system for measuring surface temperature. The surface temperature distribution on a tank fired 120-mm M-865 training projectile, with velocity of 1600 m/sec, was measured and is displayed in the report.
DTIC
Infrared Radiation; Imaging Techniques; Aerodynamic Heating; Calibrating; Image Resolution; Projectiles; Temperature Distribution

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