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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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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 **N.A.**

Includes cockpit and cabin display devices; and flight instruments.

07 Aircraft Propulsion and Power **8**

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 **9**

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

09 Research and Support Facilities (Air) **11**

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10 Astronautics **18**

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

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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
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3. Author(s) and Affiliation(s)
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AERONAUTICAL ENGINEERING

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JUNE 13, 1997

01
AERONAUTICS

19970016167 Defence Science and Technology Organisation, Div. of Airframes and Engines, Melbourne, Australia
Static and Fatigue Test Loading Development for an F-111 Bonded Composite Repair Substantiation
Walker, K., Defence Science and Technology Organisation, Australia; Swanton, G., Defence Science and Technology Organisation, Australia; Nov. 1996; 26p; In English
Report No.(s): DSTO-TN-0063; AR-009-918; Copyright; Avail: Issuing Activity (Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Vic 3001, Australia), Hardcopy, Microfiche

Static and fatigue tests of an F-111 bonded composite wing, which was repaired after the discovery of a crack in its outboard section, are described. The results of the tests were used to calibrate a detailed three-dimensional finite element model of the repaired area. A nominal section stress was then obtained and related to the Design Limit Load. The spectrum was converted, based on the static wing testing and the original stress analysis data, to represent the stress at the repaired region. The spectrum was truncated to reasonably reduce the number of cycles. The effects of static and fatigue test results, including effects of cycle matching and spectrum truncation are reported.
CASI
Composite Structures; Wings; F-111 Aircraft; Cyclic Loads; Finite Element Method; Three Dimensional Models; Static Loads

19970016812 NASA Lewis Research Center, Cleveland, OH USA
Research and Technology 1996
Mar. 1997; 196p; In English
Report No.(s): NASA-TM-107350; NAS 1.15:107350; E-10503; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

This report selectively summarizes the NASA Lewis Research Center's research and technology accomplishments for fiscal year 1996. It comprises 116 short articles submitted by the staff scientists and engineers. The report is organized into six major sections: Aeronautics, Aerospace Technology, Space Flight Systems, Engineering & Computational Support, Lewis Research Academy, and Technology Transfer. A table of contents, an author index, and a list of NASA Headquarters program offices have been included to assist the reader in finding articles of special interest. This report is not intended to be a comprehensive summary of all research and technology work done over the past fiscal year. Most of the work is reported in Lewis-published technical reports, journal articles, and presentations prepared by Lewis staff and contractors (for abstracts of these Lewis-authored reports, visit the Lewis Technical Report Server (LeTRS) on the World Wide Web-http:/letrs.lerc.nasa.gov/LeTRS/). In addition, university grants have enabled faculty members and graduate students to engage in sponsored research that is reported at technical meetings or in journal articles. For each article in this report, a Lewis contact person has been identified, and where possible, reference documents are listed so that additional information can be easily obtained. The diversity of topics attests to the breadth of research and technology being pursued and to the skill mix of the staff that makes it possible. For more information about Lewis' research, visit us on the World Wide Web (http://www.lerc.nasa.gov). Also, this document is available on the World Wide Web (http://www.lerc.nasa.gov/WWW/RT/).
Author
Aeronautical Engineering; Aeronautics; Technology Transfer; Research; Spacecraft Structures; Spacecraft Construction Materials; Spacecraft Power Supplies; Spacecraft Propulsion

02
AERODYNAMICS

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

19970015550 NASA Ames Research Center, Moffett Field, CA USA
A Survey of Theoretical and Experimental Coaxial Rotor Aerodynamic Research
Coleman, Colin P., NASA Ames Research Center, USA; Mar. 1997; 34p; In English
Contract(s)/Grant(s): RTOP 522-31-12; RTOP 522-41-22
Report No.(s): NASA-TP-3675; NAS 1.60:3675; A-975555; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The recent appearance of the Kamov Ka-50 helicopter and the application of coaxial rotors to unmanned aerial vehicles have renewed international interest in the coaxial rotor configuration. This report addresses the aerodynamic issues peculiar to coaxial rotors by surveying American, Russian, Japanese, British, and German research. (Herein, 'coaxial rotors' refers to helicopter, not propeller, rotors. The intermeshing rotor system was not investigated.) Issues addressed are separation distance, load sharing between rotors, wake structure, solidity effects, swirl recovery, and the effects of having no tail rotor. A general summary of the coaxial rotor configuration explores the configuration's advantages and applications.
Author
Rotor Aerodynamics; Research; Helicopters; Rotors

19970015641 Georgia Inst. of Tech., Contracting Support Div., Atlanta, GA USA
Dual-Mission Large Aircraft Feasibility Study and Aerodynamic Investigation ***Annual Report, Dec. 1995 - Dec. 1996***
Mavris, Dimitri, Georgia Inst. of Tech., USA; Mar. 28, 1997; 187p; In English
Contract(s)/Grant(s): NAG1-1662
Report No.(s): NASA-CR-203985; NAS 1.26:203985; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

A Dual-Mission Large Aircraft, or DMLA, represents the possibility of a single aircraft capable of fulfilling both a Global Reach Aircraft (GRA) and Very Large Transport (VLT) roles. The DMLA, by combining the GRA and VLT into a single new aircraft, could possibly lower the aircraft manufacturer's production costs through the resulting increase in production quantity. This translates into lower aircraft acquisition costs, a primary concern for both the Air Force and commercial airlines. This report outlines the first steps taken in this study, namely the assessment of technical and economic feasibility of the DMLA concept. In the course of this project, specialized GRA and VLT aircraft were sized for their respective missions, using baseline conventional (i.e., lacking advanced enabling technologies) aircraft models from previous work for the Air Force's Wright Laboratory and NASA-Langley. DMLA baseline aircraft were then also developed, by first sizing the aircraft for the more critical of the two missions and then analyzing the aircraft's performance over the other mission. The resulting aircraft performance values were then compared to assess technical feasibility. Finally, the life-cycle costs of each aircraft (GRA, VLT, and DMLA) were analyzed to quantify economic feasibility. These steps were applied to both a two-engine aircraft set, and a four-engine aircraft set.
Derived from text
Aircraft Performance; Transport Aircraft; Civil Aviation; Air Transportation; Feasibility Analysis; Aircraft Configurations; Cost Analysis

19970015682 Naval Postgraduate School, Monterey, CA USA
Investigation of the Effect of Two-Dimensional Cavities on Boundary Layers in an Adverse Pressure Gradient
Margason, Richard J., NASA Ames Research Center, USA; Mar. 1996; 286p; In English
Report No.(s): AD-A310690; NASA-TM-112819; NAS 1.15:112819; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

The present investigation evaluated one aspect of the feasibility of the use of multiple cavities as an airfoil high-lift device. The effects of cavities on the boundary layer characteristics in several pressure gradients were determined experimentally and computationally. Experimentally, it was found that up to four cavities could be deployed with only a small change to the boundary layer profiles downstream of the cavities and without significantly modifying the resultant streamwise pressure distribution. From the computational results for both of the wind tunnel test section lengths used in the experimental investigation, it was found that a grid which provided a converged solution in less than a few hundred iterations was needed before a reasonable comparison with experimental data could obtained. It was also found for these converged solutions that the appropriate grid clustering and density as well as the cell size required for a satisfactory solution was not always apparent before comparing computational results with experimental data. Overall, the investigation results show that a multiple cavity high-lift concept may be feasible.
DTIC
Investigation; Two Dimensional Bodies; Boundary Layers; Pressure Gradients; Feasibility

19970016161 Naval Postgraduate School, Monterey, CA USA

Experimental Analysis of the Wake of an Oscillating Airfoil

Dohring, Claus M., Naval Postgraduate School, USA; Jun. 1996; 148p; In English

Report No.(s): AD-A312445; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The wake of an airfoil which oscillates in pure plunge mode is investigated in a water tunnel over a wide range of reduced frequency and amplitude. The main focus of this study is the comparison of the experimentally determined wake geometry with numerical results from a potential flow code. The wake vortices are visualized by two-color dye injection and velocity profiles are measured with LDV upstream and downstream of the airfoil. Wake signatures are examined with regard to thrust or drag generation. There is a good agreement between calculated and experimental data of the vortical wavelength. At high plunge velocities both approaches show a loss of wake symmetry and the emergence of a dual mode wake behavior.

DTIC

Wakes; Vortices; Aerodynamic Drag; Airfoils; Oscillations; Flow Visualization; Flow Measurement; Potential Flow; Fluid Dynamics

19970016457 NASA Langley Research Center, Hampton, VA USA

Exploratory Investigation of Forebody Strakes for Yaw Control of a Generic Fighter with a Symmetric 60 deg Half-Angle Chine Forebody

Ross, Holly M., NASA Langley Research Center, USA; ORourke, Matthew J., Lockheed Martin Engineering and Sciences Co., USA; Apr. 1997; 72p; In English

Contract(s)/Grant(s): RTOP 505-68-30-01

Report No.(s): NASA-TP-3604; NAS 1.60:3604; L-17519; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Forebody strakes were tested in a low-speed wind tunnel to determine their effectiveness producing yaw control on a generic fighter model with a symmetric 60 deg half-angle chine forebody. Previous studies conducted using smooth, conventionally shaped forebodies show that forebody strakes provide increased levels of yaw control at angles of attack where conventional rudders are ineffective. The chine forebody shape was chosen for this study because chine forebodies can be designed with lower radar cross section (RCS) values than smooth forebody shapes. Because the chine edges of the forebody would fix the point of flow separation, it was unknown if any effectiveness achieved could be modulated as was successfully done on the smooth forebody shapes. The results show that use of forebody strakes on a chine forebody produce high levels of yaw control, and when combined with the rudder effectiveness, significant yaw control is available for a large range of angles of attack. The strake effectiveness was very dependent on radial location. Very small strakes placed at the tip of the forebody were nearly as effective as very long strakes. An axial translation scheme provided almost linear increments of control effectiveness.

Author

Forebodies; Angle of Attack; Wind Tunnel Tests; Strakes; Fighter Aircraft; Yawing Moments

19970016797 Cincinnati Univ., Dept. of Mechanical, Industrial, and Nuclear Engineering, OH USA

Control of Leading-Edge Vortices With Suction ***Final Report, 1 Sep. 1994 - 31 Aug. 1996***

Gursul, Ismet, Cincinnati Univ., USA; Oct. 22, 1996; 59p; In English

Contract(s)/Grant(s): F49620-93-1-0516

Report No.(s): AD-A320167; AFOSR-TR-97-0056; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Several control techniques have been applied in order to control leading-edge vortices at high angle of attack. The purpose of these control techniques is to influence the strength and structure of the vortices, to generate rolling moment, and to delay vortex breakdown. Since the vorticity of the leading-edge vortices originates from the separation point along the leading-edge, control of development of the shear layer has been chosen as a control strategy in several investigations: blowing and suction in the tangential direction along a rounded leading-edge.

DTIC

Leading Edges; Vortices; Angle of Attack; Tangential Blowing; Shear Layers; Rolling Moments; Wind Tunnel Tests

03
AIR TRANSPORTATION AND SAFETY

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

19970015663 Galaxy Scientific Corp., Egg Harbor Township, NJ USA
Transport Water Impact, Part 2 ***Final Report***
Tahliani, Jagdeep M., Galaxy Scientific Corp., USA; Muller, Mark, Galaxy Scientific Corp., USA; May 1996; 115p; In English
Contract(s)/Grant(s): DTFA03-89-C-00043
Report No.(s): AD-A310582; DOT/FAA/AR-95/112; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This report documents the second of a two-part program intended to study the over-water operating environment of jet transport aircraft. The report is comprised of three sections: aircraft accident analysis, airport water rescue, and emergency flotation devices. Worldwide transport airplane accident data from 1959 to the present were reviewed with an emphasis on water impact accidents and land impact accidents that occurred near airports. A sample of these land impact accidents were analyzed, using a mathematical model, to predict their outcome had they impacted a body of water. Water rescue programs at 23 national airports were surveyed addressing facilities, equipment, personnel, operations, and the airport water environment. New water rescue techniques and equipment were examined. A study of current federal regulations and NTSB recommendations regarding airport water rescue was performed. Personal flotation devices (PFDs), seat cushions, life preservers, life rafts, evacuation slides, and slide-raft combinations carried on commercial transport aircraft were studied. Relevant Federal Aviation Regulation (FARs) and Technical Standard Orders (TSOs) were reviewed. Recommendations on improving the existing regulations and incorporating new features into the devices to improve performance and reliability of the devices are discussed.
DTIC
Aircraft Accidents; Mathematical Models; Damage Assessment; Jet Aircraft; Transport Aircraft; Impact Damage; Rescue Operations

19970015850 Federal Aviation Administration, Airport and Aircraft Safety Research and Development Div., Atlantic City, NJ USA
International Conference on Cabin Safety Research ***Final Report***
Mar. 1996; 427p; In English; Cabin Safety Research, 14-16 Nov. 1995, Atlantic City, NJ, USA
Report No.(s): AD-A310506; DOT-FAA-AR-95/120; TCA-TP-12642; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

This publication contains the proceedings of the International Conference on Cabin Safety Research held in Atlantic City, New Jersey, November 14-16, 1995. Presentations were made and break out sessions were held in the following areas: evacuation, in- flight emergencies, crash dynamics and tire safety. Evacuation In-Flight Emergencies Crash Dynamics Fire Safe
DTIC
Aerodynamics; Aeronautics; Conferences; Emergencies

19970016047 Federal Aviation Administration, Atlantic City, NJ USA
Test and Evaluation Plan for Threat Image Projection with the CTX 5000 Explosives Detection System ***Final Report***
Cormier, S., Federal Aviation Administration, USA; Fobes, J., Federal Aviation Administration, USA; Sep. 1996; 75p; In English
Report No.(s): AD-A315191; AAR-510; DOT/FAA/AR-96/79; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The effectiveness of Threat Image Projection (TIP) as an element of the Screener Proficiency Evaluation and Reporting System (SPEARS) for checked baggage screening with the CTX 5000 is evaluated. The CTX 5000 combines computed tomographic imaging and automated detection of explosives. This complex system requires that screeners learn to skillfully discriminate innocent bags that cause the system to alarm from genuine threats. Testing is designed to determine the effectiveness of TIP in meeting the critical operational issues described in this plan. Specifically, is TIP effective in improving and maintaining screener performance in the detection of improvised explosive devices? Can the performance of individual screeners be monitored effectively with TIP? The testing will be conducted at airports where the CTX 5000 system is currently located.
DTIC
Explosives Detection; Computer Aided Tomography; Explosive Devices; Baggage

19970016814 NASA Ames Research Center, Moffett Field, CA USA
A Practical Guide to Interpretation of Large Collections of Incident Narratives Using the QUORUM Method
McGreevy, Michael W., NASA Ames Research Center, USA; Mar. 1997; 46p; In English
Report No.(s): NASA-TM-112190; NAS 1.15:112190; A-976313; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Analysis of incident reports plays an important role in aviation safety. Typically, a narrative description, written by a participant, is a central part of an incident report. Because there are so many reports, and the narratives contain so much detail, it can be difficult to efficiently and effectively recognize patterns among them. Recognizing and addressing recurring problems, however, is vital to continuing safety in commercial aviation operations. A practical way to interpret large collections of incident narratives is to apply the QUORUM method of text analysis, modeling, and relevance ranking. In this paper, QUORUM text analysis and modeling are surveyed, and QUORUM relevance ranking is described in detail with many examples. The examples are based on several large collections of reports from the Aviation Safety Reporting System (ASRS) database, and a collection of news stories describing the disaster of TWA Flight 800, the Boeing 747 which exploded in mid- air and crashed near Long Island, New York, on July 17, 1996. Reader familiarity with this disaster should make the relevance-ranking examples more understandable. The ASRS examples illustrate the practical application of QUORUM relevance ranking.
Author
Aircraft Safety; Flight Safety; Ranking

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

19970015557 Federal Aviation Administration, Atlantic City, NJ USA
A National Airspace System Performance Analysis Capability (NASPAC) Evaluation of the Impacts of the Center-(TRACON) Terminal Radar Approach Control Automation System (CTAS) on. Airport Capacity
Richie, Joseph M., Federal Aviation Administration, USA; Baart, Douglas, Federal Aviation Administration, USA; May 1996; 34p; In English
Report No.(s): AD-A310610; DOT/FAA/CT-TN96/14; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report documents the results and analysis of the Center-Terminal Radar Approach Control (TRACON) Automatic System (CTAS) on National Airspace System (NAS) performance. The NAS Performance Analysis Capability (NASPAC) Simulation Modeling System (SMS) was used to evaluate the impa ct CTAS would have on system level performance. Simulations were developed that included the effects CTAS would have on airport capacity and compared against simulations that did not include CTAS. Measures of delay and cost of delay were used as key metrics in the analysis. The results indicate that the deployment of CTAS would reduce operational delay and passenger delay by 34,405 and 2,277 hours respectively in 2005. These savings translate into nearly 100 million dollars.
DTIC
Radar Approach Control; National Airspace System; Terminal Guidance; Airports; Air Traffic

19970015590 Georgia Tech Research Inst., Computer Engineering Research Lab, Atlanta, GA USA
Guidance, Navigation, and Control Digital Emulation Technology Laboratory ***Final Report, 28 Sep. 1989 - 27 Sep 1996***
Alford, Cecil O., Georgia Tech Research Inst., USA; Melton, Roy, Georgia Tech Research Inst., USA; Bingham, Philip, Georgia Tech Research Inst., USA; Huang, Tsai Chi, Georgia Tech Research Inst., USA; Kubota, Toshiro, Georgia Tech Research Inst., USA; Ghannadian, Farzad, Georgia Tech Research Inst., USA; Sep. 01, 1996; 6p; In English
Contract(s)/Grant(s): DASG60-89-C-0142
Report No.(s): AD-A314456; AR-0142-96-004; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
This contract began with seven tasks: (1) Digital Emulation Facility, (2) EPA Seeker Emulator Development, (3) special Studies, (4) software Development, (5) automated Input, (6) PEP Technology, and (7) GN&C Processor Development. These tasks were developed through the first two years of the contract when virtually all funding was removed. The first was a speed test on the rad hard EPU chip developed by Harris. The second task was the development of an EPA Test System. This task was completed January 31, 1996 with a demonstration of the two units at Georgia Tech to USASSDC representatives. The two units were accepted by the government and are to be delivered to the government in accordance with their shipping orders.
DTIC
Applications Programs (Computers); Armed Forces; Research Facilities

19970016037 Department of the Navy, Washington, DC USA
Location-Corrector for Removing Sun-Induced Effects in the Global Positioning System
Chubb, Scott R., Inventor, Department of the Navy, USA; Dec. 17, 1996; 28p; In English
Patent Info.: Filed 2 Jun. 1995; US-Patent-Appl-SN-464005; US-Patent-5,585,800

Report No.(s): AD-D018370; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The system for location correction for removing the sun induced effects in the global positioning system (GPS) is disscused. This is caused by the problem of transforming the frequency of coherent radio signals to the geocentric inertial coordinate frame involves an implicit, dependence on earth-sun-clock orientation. This is accomplished by determining the systematic errors associated with sun induced effects that alter the frequency of the transmission of every satellite within the GPS because of the GPS satellites orbit around both the sun and the earth and applying a correction factor to the initially determined position to obtain the true position within 10 cm to one meter.

DTIC

Global Positioning System; Sun; Earth Orientation; Position (Location); Radio Signals; Geocentric Coordinates

19970016847 McGill Univ., Inst. of Air and Space Law, Montreal, Quebec Canada

Liability of the USA Arising Out of The Civilian Use of The Global Positioning System

Rockwell, Jeffrey A., McGill Univ., Canada; Jan. 24, 1997; 159p; In English

Report No.(s): AD-A320950; AFIT-97-003; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

As the number of civilian users of the USA Air Force's Navstar Global Positioning System (GPS) continues to increase at such a staggering rate, the government's exposure to potential liability also increases. The purpose of this thesis is to establish a legal framework to apply to GPS-related claims against the USA, primarily against the Air Force as operator of the system. Part 1 consists of three chapters. Following an introductory chapter, Chapter 2 describes the system and the general characteristics of GPS. Chapter 3 outlines the military uses of the system and the increasing and evolving civilian uses. Part II discusses the liability ramifications of providing GPS services for civilian use. Chapter IV provides the statutory bases for the U.S. government's traditional role in regulating civil aviation and maritime navigation. Chapter V analyzes the applicable domestic law under the existing statutes waiving the sovereign immunity of the USA, and Chapter VI looks at liability under international law. Chapter VII then draws some general conclusions as to how the existing law may apply to the government in regulating GPS use and operating the system itself.

DTIC

Global Positioning System; Liabilities; Law (Jurisprudence); International Law; Air Traffic Control; Civil Aviation

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970015518 NASA Dryden Flight Research Center, Edwards, CA USA

Overview of Recent Flight Flutter Testing Research at NASA Dryden

Brenner, Martin J., NASA Dryden Flight Research Center, USA; Lind, Richard C., NASA Dryden Flight Research Center, USA; Voracek, David F., NASA Dryden Flight Research Center, USA; Apr. 1997; 30p; In English; 38th; Structures, Structural Dynamics, and Materials, 7-10 Apr. 1997, Kissimmee, FL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 522-32-34

Report No.(s): NASA-TM-4792; NAS 1.15:4792; H-2165; AIAA Paper 97-1023; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In response to the concerns of the aeroelastic community, NASA Dryden Flight Research Center, Edwards, California, is conducting research into improving the flight flutter (including aeroservoelasticity) test process with more accurate and automated techniques for stability boundary prediction. The important elements of this effort so far include the following: (1) excitation mechanisms for enhanced vibration data to reduce uncertainty levels in stability estimates; (2) investigation of a variety of frequency, time, and wavelet analysis techniques for signal processing, stability estimation, and nonlinear identification; and (3) robust flutter boundary prediction to substantially reduce the test matrix for flutter clearance. These are critical research topics addressing the concerns of a recent AGARD Specialists' Meeting on Advanced Aeroservoelastic Testing and Data Analysis. This paper addresses these items using flight test data from the F/A-18 Systems Research Aircraft and the F/A-18 High Alpha Research Vehicle.

Author

Aeroservoelasticity; Flutter; Wavelet Analysis; Signal Processing; System Identification; Flight Tests; Research Aircraft

19970016204 Rensselaer Polytechnic Inst., Troy, NY USA

Development of a System for Improved Helicopter Blade Tracking ***Final Report, Sep. 1992 - Mar. 1995***

Bielawa, Richard L., Rensselaer Polytechnic Inst., USA; Frederickson, Kirk, Rensselaer Polytechnic Inst., USA; Jun. 30, 1995; 79p; In English

Contract(s)/Grant(s): DAAJ02-93-C-0013

Report No.(s): AD-A315089; RPI-D-95-1; USAATCOM-TR-95-D-9; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report presents the results of the Phase 2 experimental verification portion of a research program in support of the development of a quality control system for obtaining improved helicopter rotor blade tracking. The specific objective of the system is the accurate concurrent measurement of both the first and second mass moments (i.e., the static mass moment and the mass moment of inertia). The results of the Phase 1 study showed that, subject to the strict maintenance of linearity, the eventual system should be capable of making these measurements with accuracies to within 0.02% of nominal values. This degree of accuracy should result in blade-tracking characteristics superior to what are presently measurable and, hence, obtainable. The planned system would involve a horizontally supported blade configuration using a trapeze-like cradle suspension system. The technical basis of the measurement process involves two operations: first, the accurate measurement of the eigenvalues of the essentially rigid-body dynamic system using appropriate transient time histories, and second, the extraction of the mass moments using the measured eigenvalues, together with other known mechanical properties of the system. The experimental results of this study were twofold: (1) A series of tests were performed on a prismatic aluminum bar having length and mass characteristics of the same scale as those of a UH-6O Blackhawk helicopter rotor blade, but of as simple enough construction to enable analytical prediction of the mass characteristics, and (2) a second series of tests were similarly performed on a population of actual Blackhawk rotor blades to assess variability in properties and correlation with one/rev vibration characteristics.

DTIC

Helicopters; Rotor Blades; Quality Control; Moments of Inertia; Eigenvalues; Rotary Wings

19970016810 Santa Clara Univ., School of Engineering, CA USA

Development of Advanced Methods of Trajectory and Structural Analysis for Hypersonic Aircraft ***Final Report, 1 Oct. 1995 - 31 Jan. 1997***

Ardema, Mark D., Santa Clara Univ., USA; Mar. 03, 1997; 40p; In English

Contract(s)/Grant(s): NCC2-5165

Report No.(s): NASA-CR-203759; NAS 1.26:203759; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effort was in two areas: (1) development of advanced methods of flight path optimization, and (2) development of advanced methods of structural weight estimation.

Derived from text

Trajectory Analysis; Hypersonic Aircraft; Estimating; Structural Weight; Flight Paths

19970016841 ZONA Technology, Inc., Mesa, AZ USA

Enhancement of the Aeroservoelastic Capability in Astros ***Final Report, 1 Sep. 1995 - 1 May 1996***

Chen, P. C., ZONA Technology, Inc., USA; Liu, D. D., ZONA Technology, Inc., USA; Sarhaddi, D., ZONA Technology, Inc., USA; Striz, A. G., Oklahoma Univ., USA; Neill, D. J., Technion - Israel Inst. of Tech., Israel; Sep. 1996; 110p; In English

Contract(s)/Grant(s): F33615-95-C-3219; AF Proj. 3005

Report No.(s): AD-A315241; ZONA-96-13; WL-TR-96-3119; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This report documents the results of an STTR Phase I feasability study to investigate potential aerodynamic and aeroservoelastic enhancements to the 'Automated Structural Optimization System (ASTROS).' This study included the development of the Unified S-Domain Aerodynamics package which provides capability for aerodynamic modeling of arbitrary and complex aircraft geometries, including stores, throughout the entire flight regime, including transonic and hypersonic flight. The aerodynamics module utilizes four existing aerodynamic codes to accomplish this airload prediction capability. Additionally, a new aerodynamic geometry module was created to simplify the aerodynamic modeling of an aircraft regardless of the particular analysis code being employed. This research effort also included the development of a software design blueprint for an aeroservoelastic analysis and design module. Through a state-space formulation of the problem, this module allows the inclusion of control system design variables such as gain and phase margins, vibration frequencies, and damping ratios in the design and optimization of flexible aircraft structures.

DTIC

Feasibility Analysis; Aerodynamic Loads; Fighter Aircraft; Aircraft Models; Structural Analysis

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.

19970016225 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Physik der Atmosphaere, Oberpfaffenhofen, Germany

In-flight measurements of cruise altitude nitric oxide emission indices of commercial jet aircraft

Schulte, P., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Schlager, H., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Dec. 1995; ISSN 0943-4771; 23p; In English

Report No.(s): ETDE-DE-360; DE96-767749; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; US Sales Only; US Sales Only

Simultaneous in-situ NO and CO2 measurements on board the DLR Falcon research aircraft in the exhaust plumes of commercial short to medium range jet aircraft are used to determine lower limits for the NO(sub x) emission indices EI(NO(x)) for cruising conditions. Concentration enhancements for NO and CO2 of 9 to 33 ppbv and 4 to 14 ppmv, respectively, relative to ambient background concentrations were observed in the exhaust trails 40 s to 130 s after emission. The derived EI(NO(x))-limits range between 6.4 to 11.7 g/kg. Though the NO2 fraction in the exhaust plumes has not been measured during these pilot investigations, arguments are given that the derived lower limits represent a close approximation to the EI(NO(x)) values. Within the present uncertainties they are in agreement with predictions based on ground-based engine test data.

DOE

Exhaust Gases; Commercial Aircraft; Air Pollution; Carbon Dioxide; Nitric Oxide; Jet Aircraft; Plumes

19970016339 Phillips Lab., Propulsion Directorate, Edwards AFB, CA USA

Hybrid Propulsion for Air Force Applications Study ***Final Report, Feb. - Sep. 1995***

Mahaffy, Kevin E., Phillips Lab., USA; Harting, George C., Phillips Lab., USA; Bates, Ronald, Phillips Lab., USA; Walsh, Ray, Schafer (W. J.) Associates, Inc., USA; Hansen, Craig, Schafer (W. J.) Associates, Inc., USA; May 1996; 71p; In English

Contract(s)/Grant(s): AF Proj. 1011

Report No.(s): AD-A312696; PL-TR-96-3018; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Hybrid Propulsion for Air Force Applications Study was performed by the Air Force Phillips Laboratory at Edwards Air Force Base, California. The hybrid propulsion study's four main objectives were (1) to conduct a survey of the current state-of-the-art technology in hybrid propulsion, (2) to determine if there is a payoff for using hybrid propulsion in Air Force missions, (3) to make recommendations as to whether or not hybrid propulsion should be pursued by Phillips laboratory, and (4) if hybrid propulsion is to be pursued, produce a technology development plan. An industry survey of current state-of-the-art technology in hybrid propulsion identified several advantages and disadvantages associated with hybrid propulsion. Identified areas of concern were combustion efficiency, fuel regression rate, and mixture ratio shifts. The identified Air Force application was the use of a hybrid propulsion system in an air-to-air missile. Volume-limited designs were produced that showed that hybrid propulsion offers good potential for an air-to-air missile that can meet insensitive munitions requirements as well as provide improved energy management. A flight engagement analysis was performed to establish the mission advantage supplied by the hybrid systems formulated in the design task.

DTIC

Hybrid Propulsion; Technologies

19970016445 Georgia Tech Research Inst., Atlanta, GA USA

Broad-Based High Frequency Jet Engine Control ***Final Report, Oct. 1993 - Jul. 1995***

Prasad, J. V., Georgia Tech Research Inst., USA; Rivera, Carlos, Georgia Tech Research Inst., USA; Jan. 22, 1996; 63p; In English

Contract(s)/Grant(s): F49620-93-I-0147

Report No.(s): AD-A311100; AFOSR-TR-96-0401; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The focus of the effort being carried out under the AFOSR grant is to fully characterize the behavior of rotating stall phenomenon in turbomachinery systems and to assess effectiveness of nonlinear control strategies using both CFD simulations and experiments on the axial compressor facility in the LICCHUS lab. Toward accomplishing this objective, a CFD model has been developed and it has been validated using experimental data available in the literature. The axial compressor facility in the LICCHUS lab will be used for correlation with CFD simulations and for stall controller studies.

DTIC

Jet Engines; Engine Control; Turbomachinery; Frequency Control; Engine Parts; Turbocompressors

19970016783 Sverdrup Technology, Inc., Arnold Engineering Development Center, Arnold AFS, TN USA
Experimental Characterization of Gas Turbine Emissions at Simulated Flight Altitude Conditions ***Final Report, Jan. 1995 - Apr. 1996***
Howard, R. P., Sverdrup Technology, Inc., USA; Wormhoudt, J. C., Aerodyne Research, Inc., USA; Whitefield, P. D., Missouri Univ., USA; Sep. 1996; 158p; In English
Report No.(s): NASA-TM-112751; NAS 1.15:112751; AD-A314312; AEDC-TR-96-3; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

NASA's Atmospheric Effects of Aviation Project (AEAP) is developing a scientific basis for assessment of the atmospheric impact of subsonic and supersonic aviation. A primary goal is to assist assessments of United Nations scientific organizations and hence, consideration of emissions standards by the International Civil Aviation Organization (ICAO). Engine tests have been conducted at AEDC to fulfill the need of AEAP. The purpose of these tests is to obtain a comprehensive database to be used for supplying critical information to the atmospheric research community. It includes: (1) simulated sea-level-static test data as well as simulated altitude data; and (2) intrusive (extractive probe) data as well as non-intrusive (optical techniques) data. A commercial-type bypass engine with aviation fuel was used in this test series. The test matrix was set by parametrically selecting the temperature, pressure, and flow rate at sea-level-static and different altitudes to obtain a parametric set of data.
DTIC
Exhaust Emission; Aircraft Engines; Flight Simulation; Engine Tests; Turbofan Engines; Nonintrusive Measurement

19970016837 Purdue Univ., West Lafayette, IN USA
An Experimental Study of Swirling Flows as Applied to Annular Combustors ***Final Report***
Seal, Michael Damian, II, Purdue Univ., USA; Apr. 1997; 294p; In English
Contract(s)/Grant(s): NAS3-24350; RTOP 505-62-52
Report No.(s): NASA-CR-182271; NAS 1.26:182271; E-9867; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

This thesis presents an experimental study of swirling flows with direct applications to gas turbine combustors. Two separate flowfields were investigated: a round, swirling jet and a non-combusting annular combustor model. These studies were intended to allow both a further understanding of the behavior of general swirling flow characteristics, such as the recirculation zone, as well as to provide a base for the development of computational models. In order to determine the characteristics of swirling flows the concentration fields of a round, swirling jet were analyzed for varying amount of swirl. The experimental method used was a light scattering concentration measurement technique known as marker nephelometry. Results indicated the formation of a zone of recirculating fluid for swirl ratios (rotational speed x jet radius over mass average axial velocity) above a certain critical value. The size of this recirculation zone, as well as the spread angle of the jet, was found to increase with increase in the amount of applied swirl. The annular combustor model flowfield simulated the cold-flow characteristics of typical current annular combustors: swirl, recirculation, primary air cross jets and high levels of turbulence. The measurements in the combustor model made by the Laser Doppler Velocimetry technique, allowed the evaluation of the mean and rms velocities in the three coordinate directions, one Reynold's shear stress component and the turbulence kinetic energy: The primary cross jets were found to have a very strong effect on both the mean and turbulence flowfields. These cross jets, along with a large step change in area and wall jet inlet flow pattern, reduced the overall swirl in the test section to negligible levels. The formation of the strong recirculation zone is due mainly to the cross jets and the large step change in area. The cross jets were also found to drive a four-celled vortex-type motion (parallel to the combustor longitudinal axis) near the cross jet injection plane.
Author
Gas Turbine Engines; Combustion Chambers; Flow Distribution; Jet Flow; Turbulent Flow; Velocity Measurement; Flow Visualization; Recirculative Fluid Flow; Swirling

08
AIRCRAFT STABILITY AND CONTROL

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

19970016063 Naval Surface Warfare Center, Dept. of Combat Systems, Dahlgren, VA USA
Linearized Kappa Guidance ***Final Report***
Serakos, Demetrios, Naval Surface Warfare Center, USA; Lin, Ching-Fang, American GNC Corp., USA; Aug. 1996; 50p; In English
Report No.(s): AD-A315097; NSWCDD/TR-94/367; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An alternative solution to the ic-guidance dynamical equations is presented in this report. Kappa-guidance is a midcourse guidance algorithm which maximizes intercept velocity. The nonlinear kappa-guidance dynamical equations are linearized. The linearization is via a nonlinear coordinate transformation and nonlinear feedback. The cost function is approximated by a quadratic cost. The linear quadratic regulator (LQR) method is then used to solve the optimal control problem. A closed form solution to the LQR problem is derived for both the free and fixed final angle of approach cases. A simulation is conducted to compare the trajectories and costs of the linearized solution method and the original solution method. The results show similar performance for the two methods.
DTIC
Guidance (Motion); Surface to Air Missiles; Midcourse Guidance

19970016334 California Univ., Dept. of Mechanical Engineering, Berkeley, CA USA
Control of Slowly Varying LPV Systems: An Application to Flight Control
Lee, Lawton H., California Univ., USA; Spillman, Mark, Wright Lab., USA; Jan. 1996; 9p; In English
Report No.(s): AD-A320146; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Recent results in parameter-dependent control of linear parameter-varying (LPV) systems are applied to the problem of designing gain-scheduled pitch rate controllers for the F-16 VISTA (Variable-Stability In-Flight Simulator Test Aircraft). These methods, based on parameter-dependent quadratic Lyapunov functions, take advantage of known a priori bounds on the parameters' rates of variation (the bounds may themselves be parameter-varying). The controller achieves an induced-L2-norm performance objective; Level 1 flying qualities are predicted. Suboptimal solutions are obtained by solving a convex optimization problem described by linear matrix inequalities (LMIs). Incorporation of D-K iteration with 'constant D-scales' provides robustness to time-varying uncertainty. Parameter-varying performance weights are used to shape the desired performance at different points in the design envelope.
DTIC
Flight Control; Controllers; Control Systems Design; Aircraft Control; Linear Systems

19970016348 Air Force Inst. of Tech., National Air Intelligence Center, Wright-Patterson AFB, OH USA
Mathematical Simulation of the Three-Channel Vehicle Attitude Control System
Wu, Zhang-Cai, Chinese Academy of Space Technology, China; China Astronautics and Missilery Abstracts; Oct. 07, 1996; Volume 3, No. 1, pp. 50-59; Transl. into English of Cama, China Astronautics and Missilery Abstracts, (China) v3 n1 p50-59, 1996; In English; Translated by Leo Kanner Associates
Contract(s)/Grant(s): F33657-88-D-2188
Report No.(s): AD-A320848; NAIC-ID(RS)T-0315-96; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The necessity for and feasibility of developing mathematical simulation of the three-channel vehicle attitude control system as well as principles and methods to design the software of this simulation are described in this paper. Some examples of mathematical simulation of one-channel, two-channel and three-channel systems indicate that mathematical simulation of the three-channel system can reflect the full view and the performance index of the system completely and realistically, can exactly verify the correctness of the design theory, can provide more reliable reference curves for hardware-in-the-loop simulation of the system, and meanwhile provides important means and methods to increase the quality of the attitude system design.
DTIC
Systems Engineering; Attitude Control; Computerized Simulation; Launch Vehicles; Flight Simulation; Control Surfaces; Control Systems Design

19970016755 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
A Quantitative Feedback Theory FCS Design for the Subsonic Envelope of the Vista F-16 Including Configuration Variation and Aerodynamic Control Effector Failures
Cacciatore, Vicent J., Air Force Inst. of Tech., USA; Dec. 1995; 228p; In English
Report No.(s): AD-A312406; AFIT/GE/ENG/95D-04; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Fault tolerant flight control systems for combat aircraft are an alternative to excessively redundant aircraft designs or reconfigurable control laws. However, due to the range of flight conditions within a combat aircraft's operational flight envelope, the variety of its configurations, and the unavailability of an aerodynamic data base for damaged aircraft, designing fault tolerant systems is a complicated endeavor. Quantitative Feedback Theory is a robust control design technique especially well suited to manage the structured parametric uncertainty inherent in this problem, and consequently is applied as the primary design tool for this research. Furthermore, realistic failure models are developed for the VISTA F-16 and physical saturation constraints are applied

to the control effectors. The ensuing fault tolerant design is subjected to realistic control inputs and validated with the applicable MILSTD specifications.
DTIC
Aerodynamic Configurations; Aircraft Control; Control Surfaces; Control Theory; F-16 Aircraft; Feedback; Fighter Aircraft; Flight Control; Flight Envelopes

19970016826 NASA Dryden Flight Research Center, Edwards, CA USA
Wavelet Analyses of F/A-18 Aeroelastic and Aeroservoelastic Flight Test Data
Brenner, Martin J., NASA Dryden Flight Research Center, USA; Apr. 1997; 32p; In English; 38th; Structure, Structural Dynamics and Materials Conference Exhibit, 7-10 Apr. 1997, Kissimmee, FL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 522-32-34
Report No.(s): NASA-TM-4793; NAS 1.15:4793; H-2164; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Time-frequency signal representations combined with subspace identification methods were used to analyze aeroelastic flight data from the F/A-18 Systems Research Aircraft (SRA) and aeroservoelastic data from the F/A-18 High Alpha Research Vehicle (HARV). The F/A-18 SRA data were produced from a wingtip excitation system that generated linear frequency chirps and logarithmic sweeps. HARV data were acquired from digital Schroeder-phased and sinc pulse excitation signals to actuator commands. Nondilated continuous Morlet wavelets implemented as a filter bank were chosen for the time-frequency analysis to eliminate phase distortion as it occurs with sliding window discrete Fourier transform techniques. Wavelet coefficients were filtered to reduce effects of noise and nonlinear distortions identically in all inputs and outputs. Cleaned reconstructed time domain signals were used to compute improved transfer functions. Time and frequency domain subspace identification methods were applied to enhanced reconstructed time domain data and improved transfer functions, respectively. Time domain subspace performed poorly, even with the enhanced data, compared with frequency domain techniques. A frequency domain subspace method is shown to produce better results with the data processed using the Morlet time-frequency technique.
Author
Wavelet Analysis; Aeroelasticity; Aeroservoelasticity; Vibration Effects; System Identification; Dynamic Structural Analysis

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.

19970015543 Camber Corp., Huntsville, AL USA
Space Station Furnace Facility Management Information System (SSFF-MIS) Development ***Final Report, Dec. 1994 - Nov. 1996***
Meade, Robert M., Camber Corp., USA; Nov. 22, 1996; 17p; In English
Contract(s)/Grant(s): NAS8-39990
Report No.(s): NASA-CR-203929; NAS 1.26:203929; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report summarizes the chronology, results, and lessons learned from the development of the SSFF-MIS. This system has been nearly two years in development and has yielded some valuable insights into specialized MIS development. General: In December of 1994, the Camber Corporation and Science Applications International Corporation (SAIC) were contracted to design, develop, and implement a MIS for Marshall Space Flight Center's Space Station Furnace Facility Project. The system was to be accessible from both EBM-Compatible PC and Macintosh platforms. The system was required to contain data manually entered into the MIS as well as data imported from other MSFC sources. Electronic interfaces were established for each data source and retrieval was to be performed at prescribed time intervals. The SOW requirement that predominantly drove the development software selection was the dual-platform (IBM-PC and Macintosh) requirement. The requirement that the system would be maintained by Government personnel influenced the selection of Commercial Off-the-shelf software because of its inherent stability and readily available documentation and support. Microsoft FoxPro Professional 2.6 for Windows and Macintosh was selected as the development tool. This is a software development tool that has been in use for many years. It is stable and powerful. Microsoft has since released the replacement for this product, Microsoft Visual FoxPro, but at the time of this development, it was only available on the Windows platform. The initial contract included included the requirement for capabilities relating to the Work- and Organizational Breakdown Structures, cost (plan and actuals), workforce (plan and actuals), critical path scheduling, trend analysis, procurements and contracts, interface to manufacturing, Safety and Mission Assurance, risk analysis, and technical per-

formance indicators. It also required full documentation of the system and training of users. During the course of the contract, the requirements for Safety and Mission Assurance interface, risk analysis, and technical performance indicators were deleted. Additional capabilities were added as reflected in the Contract Chronology below. Modification 4 added the requirement for Support Contractor manpower data, the ability to manually input data not imported from non-nal sources, a general 'health' indicator screen, and remote usage. Mod 6 included the ability to change the level of planning of Civil Service Manpower at any time and the ability to manually enter Op Codes in the manufacturing data where such codes were not provided by the EMPACS database. Modification 9 included a number of changes to report contents and formats. Modification 11 required the preparation of a detailed System Design Document.
Derived from text
Space Stations; Furnaces; Camber

19970015640 NASA Langley Research Center, Hampton, VA USA
System Dynamic Analysis of a Wind Tunnel Model with Applications to Improve Aerodynamic Data Quality
Buehrle, Ralph David, Cincinnati Univ., USA; Jan. 08, 1997; 125p; In English
Contract(s)/Grant(s): RTOP 274-00-95-01
Report No.(s): NASA-TM-112690; NAS 1.15:112690; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The research investigates the effect of wind tunnel model system dynamics on measured aerodynamic data. During wind tunnel tests designed to obtain lift and drag data, the required aerodynamic measurements are the steady-state balance forces and moments, pressures, and model attitude. However, the wind tunnel model system can be subjected to unsteady aerodynamic and inertial loads which result in oscillatory translations and angular rotations. The steady-state force balance and inertial model attitude measurements are obtained by filtering and averaging data taken during conditions of high model vibrations. The main goals of this research are to characterize the effects of model system dynamics on the measured steady-state aerodynamic data and develop a correction technique to compensate for dynamically induced errors. Equations of motion are formulated for the dynamic response of the model system subjected to arbitrary aerodynamic and inertial inputs. The resulting modal model is examined to study the effects of the model system dynamic response on the aerodynamic data. In particular, the equations of motion are used to describe the effect of dynamics on the inertial model attitude, or angle of attack, measurement system that is used routinely at the NASA Langley Research Center and other wind tunnel facilities throughout the world. This activity was prompted by the inertial model attitude sensor response observed during high levels of model vibration while testing in the National Transonic Facility at the NASA Langley Research Center. The inertial attitude sensor cannot distinguish between the gravitational acceleration and centrifugal accelerations associated with wind tunnel model system vibration, which results in a model attitude measurement bias error. Bias errors over an order of magnitude greater than the required device accuracy were found in the inertial model attitude measurements during dynamic testing of two model systems. Based on a theoretical modal approach, a method using measured vibration amplitudes and measured or calculated modal characteristics of the model system is developed to correct for dynamic bias errors in the model attitude measurements. The correction method is verified through dynamic response tests on two model systems and actual wind tunnel test data.
Author
Wind Tunnel Tests; Wind Tunnel Models; Unsteady Aerodynamics; Equations of Motion; Angle of Attack; Aerodynamic Loads

19970015688 Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine, France
Piloted Simulation in Low Altitude, High Speed Mission Training and Rehearsal ***la Simulation pilotee pour l'entrainement et la preparation des missions a basse altitude et a grande vitesse***
Mar. 1997; 116p; In English
Report No.(s): AGARD-AR-333; ISBN-92-836-1050-4; Copyright Waived; Avail: CASI; A06, Hardcopy; A02, Microfiche

The subject of low altitude flying training has received increased attention in recent years for political and technical reasons, including cost, environmental impact and the expanding training requirements of modem airborne weapon systems. Conducting low-level flying training 'live' is becoming less and less acceptable in many NATO nations, while the threat continues to demand even lower altitudes at higher speeds. Restrictions on low flying training exist in many countries, and include reduced low flying time, speed restrictions, and altitudes restricted to no lower than 1000 ft. Following the AASC studies on 'Low Level Flight Training' and 'Reduction of the Environmental Impact of Operational Flying Training'. Working Group 20 was established by the AGARD Flight Mechanics Panel (now the Flight Vehicle Integration Panel) to build on their conclusions and to examine the current capability and future potential of simulation technology in low altitude high speed mission training and rehearsal. It held its first meeting in October 1991. In conducting its review, the Working Group examined some relevant mission simulators in several

NATO countries: the UK Harrier GR Mk5/7 mission simulator, the German Tornado Low-Level Test Bed simulator, and the US Apache helicopter Combat Mission Simulator.
Author (revised)
Flight Training; Systems Simulation; Flight Simulation; Combat; Flight Mechanics; Low Altitude

19970016303 NASA Lewis Research Center, Cleveland, OH USA
Compact Solar Simulator with a Small Subtense Angle and Controlled Magnification Optics
Jefferies, Kent S., Inventor, NASA Lewis Research Center, USA; Oct. 22, 1996; 12p; In English
Patent Info.: Filed 11 Oct. 1994; NASA-Case-LEW-15462-1; US-Patent-5,568,366; US-Patent-Appl-SN-322862; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

The present invention is directed to a method of simulating a pseudosun using a solar simulator. In the present invention the collector and lens of a lamp are designed to properly focus a plurality of light beams onto a segmented turning mirror. The path of light rays are traced from the lamp to the collector and then finally to the lens to control the solid and tangential magnification of the solar simulator. The segmented turning mirror is located at the focal point of the light beam and redirects the light into a vacuum chamber.
Official Gazette of the U.S. Patent and Trademark Office
Solar Simulators; Segmented Mirrors; Light Beams; Magnification; Arc Lamps

19970016374 Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine, France
Special Course on Advances in Cryogenic Wind Tunnel Technology ***les avancees en technologie des souffleries cryogeniques***
Special Course on Advances in Cryogenic Wind Tunnel Technology; Feb. 1997; 276p; In English, 20-24 May 1996, Koln, Germany; Also announced as 19970016375 through 19970016390
Report No.(s): AGARD-R-812; ISBN-92-836-1047-4; Copyright Waived; Avail: CASI; A13, Hardcopy; A03, Microfiche

The development and use of cryogenic wind tunnels represents a major advance in aerodynamics testing. One advantage of cryogenic tunnels is their ability to achieve full-scale values of Reynolds number in tunnels of moderate size at reasonable operating pressures. Another important advantage is the ability to independently vary temperature, pressure and speed, which lets one separate the effects of Reynolds number, aeroelasticity and Mach number. This series of lectures, supported by the AGARD Fluid Dynamics Panel and the von Karman Institute, incorporated a brief review of the development and early uses of cryogenic tunnels, and reports on current operational cryogenic facilities. It then covered the theory and advantages of cryogenic wind tunnels, as well as the special considerations required in their design, construction, and use. Subjects included cryogenic systems, thermal insulation, facility and model design and construction, strain-gage balances, pressure instrumentation, flow visualization, data accuracy, safety, and productivity.
Author
Cryogenic Wind Tunnels; Aerodynamics; Aeroelasticity; Flow Visualization; Boundary Layer Control; Hypersonic Flight; Laminar Flow; Incompressible Flow; Viscous Flow; Turbulent Flow

19970016375 Southampton Univ., Dept. of Aeronautics and Astronautics, UK
Introduction to Cryogenic Wind Tunnels
Goodyer, M. J., Southampton Univ., UK; Special Course on Advances in Cryogenic Wind Tunnel Technology; Feb. 1997; 14p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The situation which existed in the era which spawned the cryogenic wind tunnel, the early 1970's, is first explained. The background includes the strong desire felt at that stage to raise Reynolds number in transonic testing, together with the response in the form of the expensive solutions then under consideration. Some paper studies describing the benefits of changing test temperature did exist, mostly older and obscure, but had been ignored up to this time. This situation coincided with the contemporary state of maturity of cryogenic engineering. The cryogenic wind tunnel evolved in this environment as the way to increase Reynolds number while avoiding undue increase of wind tunnel size or operating pressure. The paper describes the theoretical principles, showing the way in which it achieves its aim. Some cryogenic wind tunne practice is included. also a description of beneficial feature additional to achieving high test Reynolds numbers. These are a rather important reduction of motor power in the case of fan-driven tunnels and the ability for the first time in wind tunnel testing to isolate the separate effects of change in Reynolds number, Mach number and dynamic pressure. Finally there is an outline of the way in which cryogenic operation affects some representative types of tunnel.
Derived from text
Cryogenic Wind Tunnels; Mach Number; Dynamic Pressure; High Reynolds Number

19970016377 Cryogenic, Marine and Materials Consultants, Southampton, UK

Materials for Use in Cryogenic Wind Tunnels

Wigley, David A., Cryogenic, Marine and Materials Consultants, UK; Special Course on Advances in Cryogenic Wind Tunnel Technology; Feb. 1997; 18p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The basic concepts of yield, plastic deformation, toughness and crack propagation are discussed in the context of those alloys likely to be used in cryogenic wind tunnels. The mechanical and physical properties of the major alloys used for model construction are discussed and summarized. Dimensional instability in 15-5PH and 17-4PH stainless steels makes them unsuitable for use, but 304L, A286, Nitronic 40 and PH13-8Mo have been used successfully. 200 grade 18 nickel maraging steel has been extensively used for constructing models and stings, but for large diameter forged bars the Charpy impact energy, Cv, at 77K falls well below the required value of 34 J. An empirical relationship between bar diameter and C(sub v) at 77K is demonstrated for samples cut in the AR, RR and RA orientations, the orientation effect being most marked between diameters of 150 and 400 mm. The use of 250 grade 18 Ni maraging steel and beryllium copper for balances is also considered. Fabrication techniques are discussed with particular reference to the dimensional changes induced by different machining operations and the implications for the fabrication of high-accuracy components. Non-conventional machining methods and various joining techniques are also discussed. The availability of information in a form suitable for use in model design and stress calculations is discussed in the light of the recent publication of the ETW Materials Guide and the data compilations in its appendices.

Derived from text

Cryogenic Wind Tunnels; Yield Strength; Plastic Properties; Toughness; Crack Propagation; Plastic Deformation

19970016378 Vigyan Research Associates, Inc., Hampton, VA USA

Cryogenic Model Systems

Young, Clarence P., Jr., Vigyan Research Associates, Inc., USA; Feb. 1997; 28p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This lecture presents current information on cryogenic model design requirements, developmental model design studies, design and fabrication experience, recent surface finish and pressure orifice studies, and current practices for filler materials and fastener applications. In addition, results of advanced model support system studies are presented along with composite model designs for cryogenic application, and information relating to cost factors for cryogenic models versus conventional models. Finally, some future development needs are suggested for cryogenic model systems.

Derived from text

Cryogenics; Design Analysis; Fabrication; Support Systems; Models

19970016379 Office National d'Etudes et de Recherches Aeronautiques, Paris, France

Instrumentation for Cryogenic Tunnels

Bazin, M., Office National d'Etudes et de Recherches Aeronautiques, France; Blanchet, C., Bertin et Cie, France; Dupriez, F., Institut de Mecanique des Fluides de Lille, France; Feb. 1997; 20p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

A few examples are given of recent work on the European Wind Tunnel (EWT): the sting balance, which is insensitive to temperature and to the thermal gradients; qualification of the transition Reynolds number in the flow; determination in the transition position on models (coating, artificial triggering, and low-temperature infrared camera); optical measurement of the model attitude; and design and construction of a civil aircraft model.

Author

Wind Tunnels; Aircraft Models; Temperature Gradients; Reynolds Number

19970016380 Technische Univ., Griesheim windkanal, Darmstadt, Germany

Force Testing with Internal Strain Gage Balances

Hufnagel, Klaus, Technische Univ., Germany; Ewald, Bernd, Technische Univ., Germany; Feb. 1997; 18p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The ever rising accuracy requirements in wind tunnel testing for airplane development enforce continuous improvement of force testing technology. The introduction of the cryogenic tunnel is an additional challenge for the force balance since now the balance accuracy is requested over an operational temperature range of 200 Kelvin. More than l5 years ago several teams in the world therefore started with investigations in the area of internal balances for cryogenic wind tunnels. In Germany in 1979 the 'Cryogenic Balance Program' was started by the German Ministry for Research and Technology with the target to develop internal balances and calibration technique for the planned cryogenic wind tunnels KKK and ETW. In the past 17 years of research all

aspects of force testing technology have been dealt with and developed to new standards by the Technical University of Darmstadt together with Deutsche Aerospace Airbus GmbH, Bremen. Within this period 8 balances for cryogenic wind tunnels were built. Basic research on the aspects of metallic spring materials resulted in new understandings about material selection and material treatment for optimum results. Principle balance design optimizations are done with finite element analysis. For the routine balance design an interactive computer program was created. The very successful technique of the Electron Beam Welded Balance was developed The balance structure is fabricated from parts, which are welded together by electron beam welding. This technigue makes it possible to build balances with a complex inner structure to minimize the interferences. For cryogenic balances the main problems are zero shift and sensitivity shift over the large temperature range and false signals especially in the axial force element due to temperature gradients. The problems were overcome by a very careful strain gage matching process by use of special gages by application of numerical corrections and by a special design of the axial force system with tandem measuring elements in the flexure groups.
Derived from text
Force Distribution; Strain Gage Balances; Cryogenic Wind Tunnels; Design Analysis; Calibrating; Accuracy; Fabrication

19970016381 Centre d'Etudes et de Recherches, Toulouse, France
Fundamental Considerations for Testing in Cryogenic Tunnels
Mignosi, Andre, Centre d'Etudes et de Recherches, France; Feb. 1997; 16p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper summarizes a number of aerodynamic phenomena mainly related to cryogenic pressurized testing. The goal of the analysis effort has been to address aerodynamic difficulties associated with the severe environment of this cryogenic wind tunnel. The first part describes some of the various flow parameters important to respect the achievement of the best similarity between an aircraft in flight and the model in the wind tunnel. The second part covers the different effects of these factors from simple 2D cases to complex 3D flows: effects of the Reynolds number on laminar and turbulent flows, boundary layer transition, influence of non adiabatic model wall. Theoretical and experimental points of view are presented and illustrated with practical examples. Efforts to obtain reliable and accurate results have been done in the past and need to be continued to provide the scientists and manufacturers which results leading to a better optimization and prediction of the aircraft performances.
Derived from text
Wind Tunnel Models; Aerodynamic Characteristics; Cryogenic Wind Tunnels; Flow Characteristics

19970016382 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fur Stromungsmechanik, Brunswick, Germany
The Cryogenic Ludwieg-Tube Tunnel at Gottingen
Rosemann, H., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Feb. 1997; 14p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The Cryogenic Ludwieg-Tube of DLR at Gottingen (KRG) is a blow-down wind tunnel designed for high Reynolds number research in transonic fow. Temperatures down to 100 K and stagnation pressures up to 1 MPa are applied to achieve Reynolds numbers of up to 60 x 10(exp 6) (2-D) based on a model chord ol I50 mm. In 1994, a new test section with 2-D adaptive walls was installed after the performance of the KRG had been evaluated with a relatively simple slotted wall test section. This paper gives an overview over the Ludwieg-Tube concept and describes the design and operation of the facility as well as the main components with special emphasis on the new 2-D adaptive wall test section and the adaptation method. Two techniques to determine transition under cryogenic conditions have been tested and will be presented. Finally, results ot the calibration program and some comparative airfoil testing including a Reynolds number study on a laminar-type airfoil will be shown.
Derived from text
Cryogenic Wind Tunnels; Test Chambers; High Reynolds Number; Transonic Flow; Walls

19970016383 Centre d'Etudes et de Recherches, Dept. of Aerothermodynamics, Toulouse, France
T2 Transonic Cryogenic Wind Tunnel at Toulouse
Seraudie, Alain, Centre d'Etudes et de Recherches, France; Archambaud, Jean Pierre, Centre d'Etudes et de Recherches, France; Feb. 1997; 14p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

T2 is an induction driven wind tunnel in which Reynolds number variations are obtained by increasing the total pressure (P(sub t)) = 1,4 to 3 bar) and reducing the total temperature (T(sub t) = 300 to 110 K). The flow is driven by an injection of dry air at ambient temperature and cooled by another injection of liquid nitrogen. This paper presents the evolution of T2 wind tunnel, mainly in cryogenic condition since 1981, and the aerodynamic cryogenic developments we performed around the wind tunnel activity. Firstly it gives the wind tunnel main characteristics, it describes the flow control system, and the hollow model technique developed for cryogenic runs. The flow quality measurements are presented, with pressure, temperature, and mass flow fluctua-

tion levels. Moisture contamination is a great problem for flow quality, and we present some solutions to perform good tests on laminar models at high Reynolds numbers. Finally this paper presents some typical results obtained in cryogenic condition: velocity measurements with a laser Doppler anemometer, transition qualification at variable Reynolds number and buffeting investigation with unsteady measurements.
Author
Cryogenic Wind Tunnels; Transonic Wind Tunnels; Reynolds Number

19970016384 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Pulheim, Kryo Kanal Koln, Cologne, Germany
The Concept of the Kryo-Kanal-Koln (KKK) Operational Experience, Flow Quality, Model Handling and Half Model Testing Technique
Viehweger, G., Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Germany; Special Course on Advances in Cryogenic Wind Tunnel Technology; Feb. 1997; 10p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The aerodynamic calibration of the KKK at ambient and cryogenic temperatures was completed in 1989. In parallel the control system of the tunnel, which is constructed in a modular basis, was modified and improved to save liquid nitrogen consumption. During this time operating problems in the circuit and in the subsystems resulting from the cryogenic mode of operation were identified and solved. Basic tests were performed to understand the physics of the desorption of moisture from the internal insulation into the circuit which resulted in a special purging procedure before cryogenic operation. The aerodynamic tests demonstrated the high flow quality in the test section in the whole operation range. This paper will give a review on the experimental experience and describes the test equipment of the tunnel.
Derived from text
Cryogenic Wind Tunnels; Calibrating; Test Chambers; Revisions

19970016385 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany
Development of Correction Procedure for Signals of Cryogenic Balances
Rebstock, R., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Feb. 1997; 12p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Requirements in accuracy and repeatability of test results given by aircraft industry are increasing more and more. Therefore, it is essential to recognize in time all influence on cryogenic balances like model weight and geometric and influence of moisture and temperature gradients top be able to lake corrections with suitable procedures. A special attention is payed on diffusion of moisture into carrier material of the strain gauges, which into be avoided by convenient coatings.
Derived from text
Correction; Procedures; Cryogenics; Balance

19970016386 Vigyan Research Associates, Inc., Hampton, VA USA
Model Dynamics
Young, Clarence P., Jr., Vigyan Research Associates, Inc., USA; Feb. 1997; 28p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Model dynamics is a continuing problem when testing in high Reynolds number, high pressure, cryogenic wind tunnels. This lecture describes model and model support vibration problems that have been encountered in the National Transonic Facility located at the NASA Langley Research Center. Test experience and studies related to identification of excitation sources, attenuation of model vibrations, and changes in structural damping at cryogenic temperatures are presented. Results of a successful buffet test conducted in the National Transonic Facility are discussed along with studies of the effects of model vibration on inertial wind-tunnel model attitude measurement devices. Finally, online model systems dynamics monitoring systems currently being used in the National Transonic Facility are described.
Derived from text
Dynamic Models; High Reynolds Number; High Pressure; Cryogenic Wind Tunnels; Vibration Effects; Dynamic Structural Analysis

19970016387 ETW G.m.b.H., Cologne, Germany
An Overview of Test Capabilities at ETW
Price, Ian, ETW G.m.b.H., Germany; Schimanski, Dieter, ETW G.m.b.H., Germany; Feb. 1997; 12p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Throughout the project stages, from the planning and design phases through to the present initial operations phase, it has always been recognized that technical excellence and productivity were fundamental to the success ot ETW. In a fiercely competitive market technical excellence must be consistent with state of the art transonic testing especially at high Reynolds numbers. Test techniques have therefore been developed to achieve the high productivity levels required by industrial users for efficient testing. This paper reviews the major features of the test techniques developed which aim at achieving a high technical quality of testing and a high productivity. Special attention has been paid to ensure that the design for high productivity, has not compromised the technical quality of the final data output.
Derived from text
Test Facilities; Project Planning; Productivity

19970016388 ETW G.m.b.H., Cologne, Germany
Cryogenic Internal Balance Calibration at ETW
Badet, L. M., ETW G.m.b.H., Germany; Feb. 1997; 16p; In English; Also announced as 19970016374; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The ETW is a closed circuit, continuous flow transonic windtunnel operating with gaseous nitrogen over a temperature range of 90 K to 313 K and up to 4.5 bar absolute total pressure. For correct simulation of real flight conditions of an aircraft in a windtunnel, the most advanced measurement techniques have to be applied. One important measuring tool is the 'Internal Strain Gauge Balance'. The Internal Balance (IB), dynamometric transducer, for a full span aircraft model is mounted between the model and the model support sting. These balances are required to measure, to the highest degree of accuracy, the aerodynamic loads acting on a model during windtunnel testing, whilst operating in the test section in conditions defined as above. to achieve high accuracies for model load measurements, the basic performance of the balances under all operating conditions and the precision of the balance calibration process prior to the test in the wind tunnel, are of fundamental importance. The aerodynamic loads acting on the model aerodynamic center during the test are represented by a vector force and a vector moment. These are both split on a reference axis system attached to the above mentioned center, into six aerodynamic components; three forces and three moments. In order to give a comprehensive aerodynamic analysis of a model under wind, the measuring instrument Internal Balance must be able to measure each of these six degrees of freedom.
Derived from text
Cryogenic Wind Tunnels; Calibrating; Balance; Strain Gage Balances; Aerodynamic Balance; Aerodynamic Characteristics; Aerodynamic Loads; Accuracy

19970016389 NASA Langley Research Center, Hampton, VA USA
The National Transonic Facility (NTF) Operational Status
Hill, Jeffrey S., NASA Langley Research Center, USA; Feb. 1997; 18p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The National Transonic Facility (NTF) is a fully operational, productive and efficient cryogenic wind tunnel currently supporting the Nation's aircraft industry needs providing flight Reynolds number research data for focused development programs as well as investigating the Reynolds number scaling phenomenon. The following presentation is a collection of viewgraphs and notes prepared from previous talks. This material is intended to provide a 'general overview' of The National Transonic Facility (NTF) Operational Status as outlined in the following Agenda.
Derived from text
Transonic Wind Tunnels; Cryogenic Wind Tunnels; Reynolds Number; General Overviews

19970016390 NASA Langley Research Center, Hampton, VA USA
Other Cryogenic Wind Tunnel Projects
Kilgore, Robert A., NASA Langley Research Center, USA; Feb. 1997; 8p; In English; Also announced as 19970016374; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The first cryogenic tunnel was built at the NASA Langley Research Center in 1972. Since then, many cryogenic wind-tunnels have been built at aeronautical research centers around the world. In this lecture some of the more interesting and significant of these projects that have not been covered by other lecturers at this Special Course are described. In this lecture authors describe cryogenic wind-tunnel projects at research centers in four countries: China (Chinese Aeronautical Research and Development Center); England (College of Aeronautics at Cranfield, and Defence Research Agency - Bedford); Japan (National Aerospace

Laboratory, University of Tsukuba, and National Defense Academy); and United States (Douglas Aircraft Co., University of Illinois at Urbana-Champaign, and NASA Langley).
Derived from text
Cryogenic Wind Tunnels; Wind Tunnel Tests; Advanced Technology Laboratory

19970016887 Federal Aviation Administration, Atlantic City, NJ USA
New Generation Runway Visual Range (RVR) Category-3b Evaluation Report
Benner, William, Federal Aviation Administration, USA; Carty, Thomas, Federal Aviation Administration, USA; Jones, Michael, Federal Aviation Administration, USA; Jul. 1996; 19p; In English
Report No.(s): AD-A314324; DOT/FAA/CT-TN95/43; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This document provides results of the Category-3b Evaluation of the New Generation Runway Visual Range (RVR) system. The evaluation was conducted from September 29 to October 8, 1994, at Mt Washington, NH. The primary purpose of the evaluation was to obtain data indicating RVR performance during actual Category-3b visibility conditions. The evaluation consisted of comparing RVR system measurements with those of human observers viewing runway lights in dense clouds and fog. Observer and RVR measurements were obtained simultaneously and recorded for statistical analysis. Approximately 500 observations were made during the evaluation under day and night conditions. In addition to using runway lights, 'black targets'--dark colored objects, were used in observations and compared with RVR measurements. The black targets were used during light conditions where they would be more visible than runway lights. Results indicated that RVR accuracy was generally within 100 feet or one reporting unit of the observed visibility.
DTIC
Runways; Visibility

19970016900 Washington Univ., Seattle, WA USA
Northwest General Aviation Airfield Pavement Performance Equations
Aim, Stephen L., Washington Univ., USA; Aug. 1996; 178p; In English
Report No.(s): AD-A315275; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Budgets for all forms of airfield construction, including maintenance and rehabilitation, continue to dwindle. With this decrease, the importance of managing existing pavement assets becomes increasingly significant. Airport managers often tend to delay pavement maintenance and rehabilitation without analyzing, or sometimes realizing, the effects of such decisions on future maintenance and rehabilitation costs. One of the most important steps to overcoming this potential problem is the emplacement of an effective pavement management system (PMS). A pavement management system is defined as a set of tools or methods that can assist decision-makers in finding cost effective strategies for providing, evaluating and maintaining pavements in a serviceable condition. A quality pavement management system provides critical information required for airport managers to properly analyze the structures under their purview. From this analysis, the airport manager can determine maintenance and rehabilitation requirements, project priorities, and can conduct more efficient long-term planning.
DTIC
General Aviation Aircraft; Cost Effectiveness; Management Systems; Pavements

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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.

19970015683 Air Force Inst. of Tech., National Air Intelligence Center, Wright-Patterson AFB, OH USA
Progress in Spacecraft Reentry Orbits and Control
Nan, Ying; Chen, Shi-Lu; China Astronautics and Missilery Abstracts; May 1996; Volume 2, No. 1, pp. 1-10; Transl. into English of China Astronautics and Missilery Abstracts (Chinese) v2 n1 p1-10 1995; In English; Translated by SCITRAN
Contract(s)/Grant(s): F33657-84-D-0165
Report No.(s): AD-A310539; NAIC-ID(RS)T-0071-96; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This article systematically summarizes the newest progress in spacecraft reentry orbits and control. Analyses are made of research results obtained from 9 specialized topics as well as of problems which exist and trends in development. These specialized topics are such ones as the presentation and significance of optimized reentry orbit calculations and control problems, characteris-

tic indicators associated with reentry flight orbits, optimized reentry orbit approximation calculations and precision numerical value solutions, reentry guidance and control systems, various types of optimized aeroassisted orbital transfer problems, composite spacecraft navigation systems, small model reentry body aerodynamic characteristics and control problems, defense penetration and interception problems during reentry flights, a number of mutual relationships between reentry problems, and so on.
DTIC
Spacecraft Reentry; Reentry Vehicles; Space Navigation; Reentry Guidance; Aeroassist; Transfer Orbits; Flight Control

19970015617 Air Force Inst. of Tech., National Air Intelligence Center, Wright-Patterson AFB, OH USA
Aerodynamic Design Research of the Gas Vane of a Solid Rocket
Zhi-heng, Liu; Missiles and Space Vehicles; Jul. 03, 1996, No. 216, pp. 9-17; Transl. into English of Missiles and Space Vehicles (China) n216 p9-17 1995; In English; Translated by Leo Kanner Associates
Contract(s)/Grant(s): F33567-88-D-2188
Report No.(s): AD-A310522; NAIC-ID(RS)T-0272-96; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Several issues involved in the aerodynamic design of the gas vane of a solid rocket, such as jet flowfield analysis, material selection and property analysis, theoretical configuration and aerodynamic characteristics design, as well as wind tunnel tests of the gas vane model and force measurement tests of a full-scale vane during rocket engine firing, etc., are presented. Integration of aerodynamic characteristics with strength, stiffness, as well as ablation value of the vane will make development of gas vanes more smooth.
DTIC
Jet Flow; Flow Distribution; Solid Propellant Rocket Engines; Aerodynamic Characteristics; Aerodynamic Configurations; Vanes; Design Analysis; Gas Flow

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.

19970015690 Virginia Univ., School of Engineering & Applied Science, Charlottesville, VA USA
NASA-UVA Light Aerospace Alloy and Structures Technology Program (LA2ST), Supplement: Research on Materials for the High Speed Civil Transport ***Progress Report, 1 Jul. - 30 Dec. 1996***
Gangloff, Richard P., Virginia Univ., USA; Starke, Edgar A., Jr., Virginia Univ., USA; Mar. 1997; 75p; In English
Contract(s)/Grant(s): NAG1-745
Report No.(s): NASA-CR-204064; NAS 1.26:204064; UVA/528266/MSE97/122; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report documents the progress achieved over the past 6 to 12 months on four graduate student projects conducted within the NASA-UVA Light Aerospace Alloy and Structures Technology Program. These studies were aimed specifically at light metallic alloy issues relevant to the High Speed Civil Transport. Research on Hydrogen-Enhanced Fracture of High-Strength Titanium Alloy Sheet refined successfully the high resolution R-curve method necessary to characterize initiation and growth fracture toughnesses. For solution treated and aged Low Cost Beta without hydrogen precharging, fracture is by ductile transgranular processes at 25 C, but standardized initiation toughnesses are somewhat low and crack extension is resolved at still lower K-levels. This fracture resistance is degraded substantially, by between 700 and 1000 wppm of dissolved hydrogen, and a fracture mode change is affected. The surface oxide on P-titanium alloys hinders hydrogen uptake and complicates the electrochemical introduction of low hydrogen concentrations that are critical to applications of these alloys. Ti-15-3 sheet was obtained for study during the next reporting period. Research on Mechanisms of deformation and Fracture in High-Strength Titanium Alloys is examining the microstructure and fatigue resistance of very thin sheet. Aging experiments on 0. 14 mm thick (0.0055 inch) foil show microstructural agility that may be used to enhance fatigue performance. Fatigue testing of Ti-15-3 sheet has begun. The effects of various thermo-mechanical processing regimens on mechanical properties will be examined and deformation modes identified. Research on the Effect of Texture and Precipitates on Mechanical Property Anisotropy of Al-Cu-Mg-X and Al-Cu alloys demonstrated that models predict a minor influence of stress-induced alignment of Phi, caused by the application of a tensile stress during aging, on the yield stress anisotropy of both modified AA2519 and a model Al-Cu binary alloy. This project is no longer included in the NASA-UVA LAST program. Research on the Creep Behavior and Microstructural stability of Al-Cu-Mg-Ag and Al-Cu-Li-Mg-Ag showed that the creep resistance of three candidate aluminum alloys (C415, C416 and ML377) was much superior compared to that of the current Concorde alloy, AA2618. Creep induced change in precipitates at grain boundaries was observed

in the alloy which exhibits the highest creep strain of the three examined. The other two alloys developed no detectable microstructural changes at grain boundaries under the creep conditions tested.
Derived from text
Supersonic Transports; X-31 Aircraft; High Strength Alloys; Thermodynamics; Structural Engineering; Microstructure; Mechanical Properties

19970016107 NASA Lewis Research Center, Cleveland, OH USA
Imaging of Combustion Species in a Radially-Staged Gas Turbine Combustor
Locke, Randy J., NYMA, Inc., USA; Hicks, Yolanda R., NASA Lewis Research Center, USA; Anderson, Robert C., NASA Lewis Research Center, USA; Ockunzzi, Kelly A., Case Western Reserve Univ., USA; Schock, Harold J., Michigan State Univ., USA; The JANNAF Combustion Subcommittee Meeting; Nov. 1996; Volume 1, pp. 11-23; In English; Also announced as 19970016105; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

Plannar laser-induced fluorescence (PLIF) is used to characterize the complex flowfield of a unique fuel-lean, radially-staged high pressure gas turbine combustor. PLIF images of OH are presented for two fuel injector configurations. PLIF images of NO, the first acquired at these conditions, are presented and compared with gas sample extraction probe measurements. Flow field imaging of nascent C2 chemiluminescence is also investigated. An examination is made of the interaction between adjoining lean premixed prevaporized (LPP) injectors. Fluorescence interferences at conditions approaching 2000 K and 15 atm are observed and attributed to polycyclic aromatic hydrocarbon (PAH) emissions. All images are acquired at a position immediately downstream of the fuel injectors with combustor burning JP-5 fuel.
Author
Combustion Control; Combustion Chambers; Laser Induced Fluorescence; JP-5 Jet Fuel; Imaging Techniques; Fuel Injection; Fluorescence

19970016128 Washington Univ., Aerospace and Energetics Research Program, Seattle, WA USA
Ignition of the Ram Accelerator: Propellant Chemistry, Mach Number, Throat Area, and Obturator Configuration Effects
Schultz, E., Washington Univ., USA; Bruckner, A. P., Washington Univ., USA; The JANNAF Combustion Subcommittee Meeting; Nov. 1996; Volume 1, pp. 409-422; In English; Also announced as 19970016105
Contract(s)/Grant(s): DAAL03-92-G-0100; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC, Hardcopy, Microfiche

The influence of several factors on the subdetonative ignition process of the ram accelerator is experimentally investigated. The ram accelerator is a hypervelocity launcher in which a subcaliber projectile, similar in shape to the centerbody of a ramjet, travels supersonically through a tube filled with premixed gaseous fuel and oxidizer. A conventional gun initially boosts the projectile to supersonic entrance velocity. A successful ram projectile start is defined as obtaining supersonic flow past the throat, while initiating and stabilizing combustion behind the throat. The primary objective of this study is to understand to what degree the propellant chemistry, entrance Mach number, throat area geometry, and obturator configuration affect the starting process. Knowledge of the influence these factors have on the starting process is important as starting conditions are changed to meet the requirements of particular applications. Experiments were conducted using methane and oxygen mixtures diluted with variable amounts of nitrogen, argon, and carbon dioxide to investigate chemistry effects. Projectile entrance Mach numbers ranged from 1.8 to 3.6 to examine Mach number sensitivity. Small changes in propellant chemistry and entrance Mach number resulted in very different outcomes for an attempted start. The flow throat to tube area ratio was modified from 0.42 to 0.59 to assess the effect of throat area geometry change on the starting process. Decreased flow throat area allows successful starting at relatively lower Mach numbers and in more energetic mixtures. Effects of the obturator configuration were studied by varying the mass from 16 g to 36 g and employing perforated and solid geometries. Increased obturator mass was found to be more conducive to igniting a given propellant mixture, and the perforated versus solid obturator results were inconclusive. This paper presents the experimental data acquired while studying the aforementioned factors and provides the current understanding of the ram accelerator starting process.
Author
Ram Accelerators; Ramjet Engines; Hypervelocity Launchers; Propellant Chemistry; Projectiles; Supersonic Flow

19970016406 California Univ., Dept.f Materials Science and Mineral Engineering, Berkeley, CA USA
Micromechanisms of High-Temperature Fatigue-Crack Growth and Low-Temperature Toughness in Monolithic and Composite Intermetallic Alloys ***Final Report, 9 Mar. 1995 - 29 Feb. 1996***
Rao, K. T. Venkateswara, California Univ., USA; Ritchie, R. O., California Univ., USA; Apr. 01, 1996; 91p; In English
Contract(s)/Grant(s): F49620-93-1-0107; AF Proj. 2306
Report No.(s): AD-A311154; UCB/R/96/A1116; AFOSR-TR-96-0384; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The next generation of high-performance gas-turbine engines will require stiffer materials, operating at higher stress levels and capable of withstanding higher temperatures. Candidate materials for such applications include ordered intermetallics, ceramics and composites based on metal, intermetallic, ceramic and carbon matrices, all of which are currently of limited use due to their low ductility and toughness at room temperature. Several toughening strategies have been explored to develop intermetallic alloys for structural use, and their room temperature crack-growth properties, both under monotonic and cyclic loading, have been recently characterized in some detail. However, there is still a paucity of crack-growth data in these materials, especially at high temperatures, and a lack of understanding of the salient mechanisms governing crack growth in these materials at these temperatures. Accordingly, the present research is aimed at examining the fatigue-crack growth and fracture behavior in various intermetallic alloys, with special emphasis on the effect of ambient-temperature toughening mechanisms on high-temperature cyclic crack-growth resistance.
DTIC
Crack Propagation; Fatigue (Materials); Micromechanics; Intermetallics; Gas Turbine Engines; Titanium Alloys; Niobium Alloys; Microstructure; Fracture Strength

12
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.

19970015549 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Time Correlations and the Frequency Spectrum of Sound Radiated by Turbulent Flows ***Final Report***
Rubinstein, Robert, Institute for Computer Applications in Science and Engineering, USA; Zhou, Ye, Institute for Computer Applications in Science and Engineering, USA; Physics of Fluids; Jan. 1997; 30p; In English
Contract(s)/Grant(s): NAS1-19480; RTOP 505-90-52-01
Report No.(s): NASA-CR-201648; NAS 1.26:201648; ICASE -97-7; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Theories of turbulent time correlations are applied to compute frequency spectra of sound radiated by isotropic turbulence and by turbulent shear flows. The hypothesis that Eulerian time correlations are dominated by the sweeping action of the most energetic scales implies that the frequency spectrum of the sound radiated by isotropic turbulence scales as omega(exp 4) for low frequencies and as omega(exp -3/4) for high frequencies. The sweeping hypothesis is applied to an approximate theory of jet noise. The high frequency noise again scales as omega(exp -3/4), but the low frequency spectrum scales as omega(exp 2). In comparison, a classical theory of jet noise based on dimensional analysis gives omega(exp -2) and omega(exp 2) scaling for these frequency ranges. It is shown that the omega(exp -2) scaling is obtained by simplifying the description of turbulent time correlations. An approximate theory of the effect of shear on turbulent time correlations is developed and applied to the frequency spectrum of sound radiated by shear turbulence. The predicted steepening of the shear dominated spectrum appears to be consistent with jet noise measurements.
Author
Turbulent Flow; Aeroacoustics; Sound Propagation; Shear Flow; Isotropic Turbulence; Jet Aircraft Noise; Frequency Distribution

19970015845 Naval Air Warfare Center, Patuxent River, MD USA
VH3D/6ON Electromagnetic Pulse Hardness Assurance, Maintenance, and Surveillance Program
Mallory, Mark, Naval Air Warfare Center, USA; Frazier, Sam, Naval Air Warfare Center, USA; Jun. 18, 1996; 18p; In English
Report No.(s): AD-A314199; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report discusses the Hardness Assurance, Maintenance, and Surveillance (HAMS) program. It includes system level tests, aircraft MODs, field surveillance tests, VH HAMS databases and program milestones and responsibilities.
DTIC
Attack Aircraft; Helicopters; Aircraft Maintenance; Avionics

19970016065 Air Force Inst. of Tech., National Air Intelligence Center, Wright-Patterson AFB, OH USA
Experimental Investigation on Energy Distribution of Output Beam of a Positive-Branch Confocal and Unstable Resonator
Huizhi, Yan, Air Force Inst. of Tech., USA; Chinese Journal of Lasers; Aug. 26, 1996; Volume 16, No. 1, pp. 49-52; Transl. into English of Zhongguo Jiguang (Chinese Journal of Lasers) (China), v16 n1 p49-52, 1989; In English; Transl. of Zhongguo Jiguang
Report No.(s): AD-A315185; NAIC-ID(RS)T-0167-96; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
With regard to combustion driven supersonic diffusion mixed models of continuous wave DF chemical laser positive branch confocal nonstable resonator output beams, experimental research was done on proximate and distant field energy distributions. Measurements clearly showed that test measurements and theoretical analysis were basically in agreement.
DTIC
Chemical Lasers; Supersonic Combustion; Continuous Wave Lasers; DF Lasers; Energy Distribution; Laser Outputs

19970016074 Wright Lab., Aero Propulsion and Power Directorate, Wright-Patterson AFB, OH USA
Aero-Thermal Cascade Tunnel Flow Quality: Turbulence Generation and Prediction ***Final Report, 1 Nov. 1995 - 9 Jul. 1996***
Duncan, John, Wright Lab., USA; Petersen, Kristin, Wright Lab., USA; Nov. 29, 1995; 94p; In English
Contract(s)/Grant(s): AF Proj. 2307
Report No.(s): AD-A312457; WL-TR-96-2095; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
Turbine blade temperatures in modern turbine engines are the limiting factor in the advancement of aircraft propulsion today. One reason for the blades' thermal stress failure has to do with the traverse effects of turbulent flow over the blades--the more turbulence in the flow, the greater the heat transfer to the blade. of concern here are both freestream and boundary layer turbulence. Therefore, the focus of much research today is on studying turbine blade models with post-burner turbulent flow conditions in order to design and build blades around the predicted failure levels and coordinates. The focus of this paper is on the generation of the turbulence characteristics which will be necessary for use in cascade wind tunnel facilities. Methods of turbulence generation and turbulence trends are analyzed with the main parameter being turbulence intensity variation with both lateral and streamwise location. The results presented here are a complete turbulent flow field description for a turbulence generation method, supporting the 'air off' grid configuration as ready for use and research while demanding revision of the 'air on' high turbulence generation method.
DTIC
Heat Transfer; Aircraft Engines; Aerodynamic Heating; Flow Distribution; Thermal Stresses; Turbine Blades; Turbine Engines; Turbulent Boundary Layer

19970016075 Wright Lab., Wright-Patterson AFB, OH USA
Low Reynolds Number Turbine Blade Cascade Calculations ***Final Report, 1 Nov. 1995 - 9 Jul. 1996***
Rivir, Richard B., Wright Lab., USA; Sondergaard, Rolf, Wright Lab., USA; Dahlstrom, Michael, Wright Lab., USA; Ervin, Elizabeth, Wright Lab., USA; Jan. 1996; 15p; In English
Contract(s)/Grant(s): AF Proj. 2307
Report No.(s): AD-A312466; WL-TR-96-2087; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Computations of the velocity fields for Langston turbine blade cascades with solidities of 1.075 and 0.84 have been carried out at Reynolds numbers of 50K, 100K, 200K, 441K, 1000K, and 2000K. A second cascade investigated at Reynolds numbers of 50K and 100K uses the Langston airfoil which has been modified by extending the trailing edge, resulting in a solidity of 0.786. The computations were performed with Allison's Blade Vanc Interaction code. Computational results are presented for transition, separation, and reattachment.
DTIC
Low Reynolds Number; Turbine Blades; Airfoils

19970016191 Army Aeromedical Research Lab., Fort Rucker, AL USA

U.S. Army Aviation Epidemiology Data Register: Distribution of Sitting Heights Among Army Aviation Training Applicants, 1986 to 1995 ***Final Report***

Mason, Kevin T., Army Aeromedical Research Lab., USA; Shannon, Samuel G., Army Aeromedical Research Lab., USA; Jul. 1996; 15p; In English

Contract(s)/Grant(s): DA Proj. 301-62787-A-878

Report No.(s): AD-A314708; USAARL-96-31; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Aviation Training Brigade, U.S. Army Aviation Center, Fort Rucker, Alabama, and the U.S. Army Aeromedical Center, Fort Rucker, Alabama, requested an analysis of the distribution of sitting heights among male and female applicants for entry into the Army Aviation Branch. They may revise the current sitting height entry standard of 'less than or equal to 102 centimeters' to a new qualification standard as low as 'less than or equal to 97 centimeters.' The analysis was conducted with a query of the U.S. Army Aviation Epidemiology Data Register. Flying duty medical examination data on applicant status, class of officer commissioning, gender, and sitting height were extracted for all Army aviator training applicants for the period 1 January 1986 to 31 December 1995. The analysis showed that adoption of the lower standard (97 centimeters) would reduce the aviator training applicant pool by as much as 9.57 percent. Warrant officer applicants have a slightly greater risk for aeromedical disqualifications due to sitting heights exceeding the proposed standard than commissioned officer applicants (Relative risk (Katz) = 1.13, CI 0.95 = 1.06, 1.23). Male applicants would carry almost the entire burden of the increased risk for aeromedical disqualification if the sitting standard was changed (Relative risk (Katz) = 19.6, CI 0.95 = 9.83, 39.3).

DTIC

Aerospace Medicine; Physical Examinations; Aircraft Pilots; Height; Standards

19970016330 Little (Arthur D.), Inc., Cambridge, MA USA

Prediction and Control of Heat Treat Distortion of Helicopter Gears ***Final Report, Jun. 1992 - May 1995***

Stingfellow, R., Little (Arthur D.), Inc., USA; Aug. 1995; 194p; In English

Contract(s)/Grant(s): DAAJ02-92-C-0030

Report No.(s): AD-A314275; USAATCOM-TR-95-D-5; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

A helicopter gear heat treatment distortion modelling approach was developed using a commercially available finite element program. The model. predicts distortion and residual stresses resulting from carburization, harden/quench and temper processes performed on gears fabricated from 9310 steel. Accurate prediction of heat treatment distortion could aid in the design of gears, heat treatment processes and quench dies to reduce distortion. This would result in a significant reduction in scrap and rework for new gear designs. The model development included the development of constitutive equations, gathering of materials property data and determination of heat transfer coefficients. The model was demonstrated on a simple flat disk geometry and a rim/web/accessory gear blank. Model results are compared to experimental heat treatments of these configurations.

DTIC

Gears; Heat Treatment; Helicopters; Finite Element Method; Constitutive Equations; Heat Transfer Coefficients; Distortion; Computerized Simulation

19970016418 Wright Lab., Wright-Patterson AFB, OH USA

Separating and Separated Boundary Layers ***Final Report, 1 Nov. 1995 - 9 Jul. 1996***

Simon, Terrence W., Minnesota Univ., USA; Volino, Ralph J., Minnesota Univ., USA; Feb. 1996; 25p; In English

Contract(s)/Grant(s): AF Proj. 2307

Report No.(s): AD-A312504; WL-TR-96-2092; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The low-pressure turbine of an aircraft engine operates with a low chord Reynolds number. As such, there are regions of strong streamwise acceleration and diffusion effects. This results in extended regions of transition from laminar to turbulent flow and large zones of flow separation. In response to a need to learn more about the mechanisms that lead to transition and separation in the engine environment, a low-Reynolds-number-flow study initiated during the Summer of 1994 at Wright Labs. In this project, a low-pressure turbine airfoil cascade was installed in a wind tunnel. to simulate the engine environment, high background turbulence was imposed on the flow and a device for imposing passing wakes upon the flow was fabricated. A program for measurement of the characteristics of the boundary layer; laminar-like or turbulent, separated or attached, was initiated. The Summer project resulted in an effective start on the problem but considerably more remained to be done. This report documents the subsequent work on this project. At the University of Minnesota, an easily accessible facility which had the essential elements of the low-pressure turbine flow was designed, built, and qualified. This facility now provides a convenient means for documenting the flow and developing measurement techniques. The Wright Lab experimental program continued with the completion of the construction, the implementation of the turbulence generating device, and the qualification of the tunnel. Both facilities are now

producing data to the program. These data are summarized herein. The University of Minnesota facility has generated pressure profiles for various cases of different Reynolds number and turbulence intensity. The Wright Labs facility has given pressure profiles for various Reynolds numbers.
DTIC
Boundary Layer Separation; Boundary Layer Transition; Gas Turbines; Separated Flow; Aircraft Engines; Wind Tunnel Tests; Reynolds Number; Pressure Distribution; Pressure Measurement

19970016774 Synthetic Environments, Inc., McLean, VA USA
Eye/Voice Mission Planning Interface (EVMPI), Phase 1 ***Final Report, 12 May - 11 Dec. 1995***
Hatfield, Franz, Synthetic Environments, Inc., USA; Jenkins, Eric A., Synthetic Environments, Inc., USA; Jennings, Michael W., Synthetic Environments, Inc., USA; Dec. 1995; 113p; In English
Contract(s)/Grant(s): F41624-95-C-6012; AF Proj. 3005
Report No.(s): AD-A308044; TR-J103-1; AL/CF-TR-1995-0204; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
Pilots and other crew station operators need better ways of interacting with their systems, including more efficient human-machine dialog and better physical interface devices and interaction techniques. The goal of the Eye/Voice Mission Planning Interface (EVMPI) research is to integrate voice recognition and eye-tracking technology with aviation displays in order to reduce pilot cognitive and manual workload. The EVMPI technology allows an operator to gaze on user interface items of interest and issue verbal commands/queries that can be interpreted by the system, thus permitting hands-free operation of cockpit displays. This report describes the concept for the EVMPI, general principles for integrating eye and voice input, an EVMPI architecture, and the user interface implementation and evaluation of several aviation mission planning tasks. A primary benefit that arises from the integration of multiple input modalities to infer user intent is that robust performance can be obtained, even when the component technologies (eye and voice) are imperfect. This reduces the accuracy requirements on the individual technologies. GOMS models for eye/voice and conventional throttle/stick interaction protocols were developed for a select set of operator tasks. A preliminary comparison reveals that eye/voice interaction can significantly reduce the total number of operations that need to be performed in particular tasks. Additional empirical research is required to substantiate these findings and to generalize the results to broad classes of operator tasks.
DTIC
Cockpits; Flight Crews; Eye (Anatomy); Display Devices; Man Machine Systems; Verbal Communication

13
GEOSCIENCES

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

19970016729 Johnson Controls, Inc., Milwaukee, WI USA
Development of a Bipolar Lead/Acid Battery for the More Electric Aircraft ***Final Report, 1 Sep. 1991 - 30 Sep 1995***
Rose, Jennifer L., Johnson Controls, Inc., USA; Sep. 1995; 93p; In English
Contract(s)/Grant(s): F33615-91-C-2142; AF Proj. 3145
Report No.(s): AD-A310461; WL-TR-95-2111; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
This report summarizes the development work completed under contract F33615-91-C-2142 for the time period of September 1991 to September 1995. Initial work targeted the development of a filled polymeric composite substrate for use in a true bipolar lead acid battery. Efforts were refocused on metallic substrate technology in Month 33, and concluded with the delivery of battery systems to Wright Laboratory.
DTIC
Aircraft Engines; Lead Acid Batteries; Product Development

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LIFE SCIENCES

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

19970014928 Tennessee Univ., Knoxville, TN USA
The Effects of Color to the Eye and its Importance for Heliport Lighting
Ernst, Craig A., Tennessee Univ., USA; Aug. 1996; 53p; In English; Original contains color plates
Report No.(s): AD-A311260; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The objective of this thesis is to determine the optimum color for heliport approach lighting. Changes in air navigation from terrestrial based navigation aids to satellite based navigation aids will provide heliports with a precision instrument approach capability never realized before. This advancement in air navigation has created a requirement for better heliport approach lighting systems. by studying the physiological and psycophysical capabilities of the eye and it's imperfections, a scientific selection of color that enhances the eye's performance can be achieved. The results of field testing, using an experimental helipad, has shown that light at a wavelength of approximately 525 microns (green-blue) could very well be the best color for heliport approach lighting systems.
DTIC
Lighting Equipment; Aircraft Landing; Air Navigation

19970016188 Armstrong Lab., Brooks AFB, TX USA
Active Duty Air Force Behavioral Risk Factor Surveillance Pilot Project, 1995 ***Final Report, Jul. - Aug. 1995***
Robbins, Anthony S., Armstrong Lab., USA; Jul. 1996; 100p; In English
Report No.(s): AD-A310663; AL/PS-TR-1996--0060; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

Active Duty' Air Force (ADAF) Behavioral Risk Factor Surveillance Pilot Project, 1995, provides results of a survey on the prevalence of behavioral risk factors among ADAF members. This study, conducted during July and August 1995, is the first USAF-wide survey to provide such data at the major command level. Results showed that the Air Force is currently meeting these national Healthy People 2000 goals: overweight by body mass index, safety belt usage, child safety seat usage, ever having had a mammogram and breast exam, ever having had a Pap smear, and having had a Pap smear in the past three years. One major finding was the lower than expected prevalence of current smoking (reported by 22.4% of ADAF members). A second major finding concerned alcohol abuse behaviors. The prevalence of self-reported binge drinking was 26%. Chronic drinking (4.1% vs. 3.0% nationally) and drinking and driving (2.6% vs. 2.4% nationally) were not markedly different from US findings. Data also indicated that the Air Force has not met Healthy People 2000 goals for periodic cholesterol testing, suggesting another opportunity for improvement. The recommendation is to institute an annual behavioral risk factor survey for the Air Force.
DTIC
Body Weight; Physiological Factors; Aircraft Pilots

19970016807 Civil Aeromedical Inst., Federal Aviation Administration, Oklahoma City, OK USA
Effects of Mild Hypoxia on Pilot Performance at General Aviation Altitudes ***Final Report***
Nesthus, Thomas E., Civil Aeromedical Inst., USA; Rush, Ladonna L., Civil Aeromedical Inst., USA; Wreggit, Steven S., Civil Aeromedical Inst., USA; Apr. 1997; 50p; In English
Report No.(s): DOT/FAA/AM-97/9; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

General aviation pilots may fly continuously at altitudes up to 12,500 ft. without the use of supplemental oxygen. However, hypoxia is a condition that can develop at altitudes under 12,500 ft. Research has shown highly variable tolerance and performance of individuals during low altitude laboratory exposures with simple and complex tasking. This study evaluated the physiological and subjective responses, as well as the simulated flight performance of general aviation pilots during a cross-country flight scenario. Ten pilots of a mild hypoxia group were compared with 10 pilots of a normoxic control group. Measurements of flight performance from the Basic General Aviation Research Simulator (BGARS) and of flight-following procedures were gathered during a 3-day, 2 hr. per day, cross-country flight scenario. Determined by group membership and terrain elevation during the cross-country flight, subjects breathed either oxygen mixtures simulating sea level, 8,000 ft., 10,000 ft., and 12,500 ft. altitudes or compressed air, throughout. The physiological measures of oxygen and carbon dioxide partial pressures (PtcO2 and PtcCO2), heart rate (HR), and blood oxygen saturation (SaO2), provided significant results differentiating the 2 pilot groups and the 4 altitude conditions of the hypoxia group. No significant deviations from assigned altitude, VOR radials, or heading were found during cruise flight. However, significantly more procedural errors were committed by the hypoxia group during cruise flight at 10,000 ft. and during the descent and approach phases of flight from 10,000 ft. on Day 3 and during descent from 12,500 ft. on Day 4. Subjective measures of symptoms, workload, and stress provided limited evidence of hypoxic effects, although the hypoxia group reported signif-

icantly greater demands on their time during flight, compared to the control group. Also, significant group differences were found in flight following procedural errors, particularly during the descent and approach phases of flight. Recommendations are made to encourage GA pilots to plan their descents from flights above 10,000 ft. to allow sufficient recovery time as a routine precaution to the often undetectable effects of mild hypoxia.
Author
Hypoxia; Pilot Performance; General Aviation Aircraft; Physiological Responses; Altitude; Physiological Tests

19970016885 Army Aeromedical Research Lab., Fort Rucker, AL USA
Physiological and Psychological Effects of Thermally Stressful UH-6O Simulator Cockpit Conditions on Aviators Wearing Standard and Encumbered Flight Uniforms ***Final Report***
Reardon, Matthew, Army Aeromedical Research Lab., USA; Smythe, Nicholas, III, Army Aeromedical Research Lab., USA; Omer, Julia, Army Aeromedical Research Lab., USA; Helms, Beth, Army Aeromedical Research Lab., USA; Hager, J. Darrell, Army Aeromedical Research Lab., USA; Freeze, Marjorie, Army Aeromedical Research Lab., USA; Buchanan, Donna, Army Aeromedical Research Lab., USA; Dec. 1996; 117p; In English
Contract(s)/Grant(s): DA Proj. 3M1-62787-A-879
Report No.(s): AD-A320166; USAARL-97-06; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
This study evaluated the effects of the four combinations of unencumbered MOPPO aviator battle dress uniform (ABDU) and encumbered MOPP4 over ABDU flight ensembles in cool (70 F, 50 percent relative humidity (RH)) and hot (100 F, 50 percent RH) UH-60 cockpit conditions. This report describes the physiological and psychological responses. The most striking, operationally relevant result was that none of the crews in the encumbered MOPP4 hot condition were able to complete the first two 2-hour sorties movements. The results of this evaluation suggest that future rotary-wing aviator flight uniform components should be designed to be lighter weight and allow greater evaporation of sweat. Methods should be sought to improve fit and comfort, particularly for the mask and helmet combination, as well as prevent pressure discomfort over the back due to the life raft. The 11.7 lb ballistic protective plate also should be lighter weight and reduced in thickness. Forced dry air microclimate cooling into the ensemble should be considered for reducing heat accumulation in the encumbered MOPP4 aviator ensemble by enhancing evaporative cooling and thereby increasing endurance times during hot weather operations.
DTIC
Physiological Effects; Psychological Effects; Aircraft Pilots; Cockpits; Psychological Tests; Physiological Tests; Helicopters; Temperature Effects; Pilot Performance; Evaporative Cooling

15
MATHEMATICAL AND COMPUTER SCIENCES

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

19970015659 Federal Aviation Administration, Civil Aeromedical Inst., Oklahoma City, OK USA
Aviation Topics Speech ACTS Taxonomy (ATSAT) pc User's Guide. Version 2.0 ***Final Report***
Prinzo, O. Veronika, Federal Aviation Administration, USA; Maclin, Otto, Federal Aviation Administration, USA; Aug. 1996; 23p; In English
Contract(s)/Grant(s): DTFA02-91-C-91089
Report No.(s): AD-A314179; DOT/FAA/AM-96/20; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
ATSATpc is a Windows(TM)-based software program designed to facilitate posting of transcribed voice communications data into a pre-defined electronic spreadsheet. The steps involved in processing air traffic control communications using ATSATpc coincide with the steps that must be followed when manually encoding communications according to the procedures outlined in Development of a Coding Form for Approach Control/Pilot Voice Communications (Prinzo, Britton, & Hendrix, 1995).
DTIC
Air Traffic Control; Approach Control; Voice Communication

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.

19970016053 Electricite de France, Clamart, France
Numerical study of jet noise radiated by turbulent coherent structures
Bastin, F., Electricite de France, France; Aug. 1995; 160p; In French
Report No.(s): EDF-96-NV-00015; DE96-779589; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche; US Sales Only; US Sales Only

A numerical approach of jet mixing noise prediction is presented, based on the assumption that the radiated sound field is essentially due to large-scale coherent turbulent structures. A semi-deterministic turbulence modelling is used to obtain the flow coherent fluctuations. This model is derived from the k-epsilon model and validated on the 2-D compressible shear layer case. Three plane jets at Mach 0.5, 1.33, and 2 are calculated. The semi-deterministic modelling yields a realistic unsteady representation of plane jets but not appropriate for axisymmetric jet computations. Lighthill's analogy is used to estimate the noise radiated by the flow. Three integral formulations of the theory are compared and the most suitable one is expressed in space-time Fourier space. This formulation is associated to a geometrical interpretation of acoustic computations in (k, omega) plane. The only contribution of coherent structures cannot account for the high-frequency radiation of a subsonic jet and thus, the initial assumption is not verified in the subsonic range. The interpretation of Lighthill's analogy in (k, omega) plane allows to conclude that the missing high-frequency components are due to the inner structure of the coherent motion. For supersonic jets, full acoustic spectra are obtained, at least in the forward arc where the dominant radiation is emitted. For the fastest jet (M = 2), no Mach waves are observed, which may be explained by a ratio of the structures convection velocity to the jet exit velocity lower in plane than in circular jets. This point is confirmed by instability theory calculations. Large eddy simulations (LES) were performed for subsonic jets. Data obtained in the plane jet case show that this technique allows only a slight improvement of acoustic results. to obtain a satisfactory high-frequency radiation, very fine grids should be considered, and the 2-D approximation could not be justified anymore.
DOE
Jet Aircraft Noise; K-Epsilon Turbulence Model; Noise Prediction; Turbulent Flow; Two Dimensional Jets; Supersonic Jet Flow; Aerodynamic Noise; Aeroacoustics

19970016922 Army Research Lab., Battlefield Environment Directorate, White Sands Missle Range, NM USA
Comparison Between the Scanning Fast-Field Program and Helicopter Data ***Final Report***
Noble, John M., Army Research Lab., USA; Barnes, Michael, New Mexico State Univ., USA; Dec. 1995; 58p; In English
Report No.(s): AD-A310560; ARL-TR-824; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A study was conducted to compare the Fast Field Program (FFP) to data from helicopters out to a range of 20 km. The purpose of the study was to observe how the FFP predictions compared to helicopters over ranges out to 20 km and determine if the FFP could reliably be used to predict the propagation conditions for acoustic arrays listening for helicopters. The helicopter data consisted of many passes of a variety of helicopters over a period of several weeks to obtain a large set of data collected under many different acoustic propagation conditions. Simultaneous acoustic and meteorological data was collected during the experiment. The meteorological data consisted of surface observations of relative humidity and pressure with winds measured from the surface to 2 km and the temperature measured from the surface to 400 m. This provided a good set of meteorological data to use as input to the FFP for the comparisons. For most of the comparisons made, the signal-to-noise ratio for the acoustic data was quite good which contributed to the comparison. For the cases where the signal-to-noise ratio was not good, the FFP provided a good comparison until the signal was buried in the noise. The results of the comparison shows that the FFP predictions agreed very well with the trends in the helicopter data.
DTIC
Acoustic Measurement; Acoustic Propagation; Helicopters; Meteorological Parameters; Signal to Noise Ratios

19970016341 Oklahoma State Univ., School of Mechanical and Aerospace Engineering, Stillwater, OK USA
Hydraulic and Thermal Performance Tests on a High Heat Flux Heat Exchanger with PAO as the Coolant ***Final Report, 1 Sep. 1994 - 31 Dec. 1995***
Ghajar, Afshin J., Oklahoma State Univ., USA; Cutbirth, Michael, Oklahoma State Univ., USA; May 1996; 266p; In English
Contract(s)/Grant(s): F33615-94-C-2419; AF Proj. 3145
Report No.(s): AD-A310271; WL-TR-96-2066; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

With new aircraft navigation, communications and countermeasures equipment requiring numerous data processing units, today's military aircraft is experiencing an increasing dependence on electronics. Furthermore, the power densities and ensuing waste heat fluxes of electronic chips are increasing as designers strive to improve processing speeds. One concept being proposed to meet the stringent cooling requirements of these advanced electronics is the High Flux Heat Exchanger, HFHE, developed by McDonnell Douglas. The HFHE consists of 20 Compact High Intensity Coolers, CHICs developed by Sundstrand and capable of handling 100 W/sq cm each and arranged in a grid on a SEM-E card. This translates into a total cooling capacity of 2000 W. The design point for the HFHE was to deliver 2000 Watts of cooling while maintaining electronics junction temperatures at less than 900C using polyalphaolefin in (PAO) as the coolant. The purpose of this effort was to determine HFHE hydraulic and thermal performance. Results were obtained for flow rates of 1.0 to 4.0 kg/min over a temperature range of -10 to 40 C and for heat loads up to 100 W. Using these results, pump size and the flow rates needed for sufficient thermal performance of the HFHE were estimated.
DTIC
Heat Exchangers; Thermodynamic Properties; Military Aircraft; Cooling; Aircraft Equipment; Heat Flux; Performance Tests; Temperature Effects

17
SOCIAL SCIENCES

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

19970016903 North Dakota State Univ., Dept. of Computer Science and Operations Research, Fargo, ND USA
Distributed Optimization for Customized Aircraft Fleet Scheduling ***Final Report, 1 Jul. 1994 - 31 Dec. 1995***
Nygard, Kendall E., North Dakota State Univ., USA; Dec. 31, 1995; 93p; In English
Contract(s)/Grant(s): F49620-94-I-0411; AF Proj. 3484
Report No.(s): AD-A311088; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

DAKOTA is a software environment for aircraft scheduling. Important features of the system include an extended set partitioning algorithm for optimizing schedules, a geographic-based display subsystem, schedule editing tools, context-sensitive hyperhelp, and report writing facilities. The goal is to provide a system that can help users quickly produce aircraft schedules that efficiently utilize the available fleet. The manual schedule editing procedures and the optimizer work seamlessly, making the best of both approaches available to the scheduler. Designed from the perspective of the end user, DAKOTA is a comprehensive flight scheduling system that is easy to use, and easy to master. Designing and implementing high-quality graphical human-computer interfaces is a challenging process. In this report, some of the user interface design choices are presented and analyzed. The fundamental problem addressed is the need to arrange customized air travel military personnel (clients) who submit travel requests composed of one or more origin-destination pairs called request legs.
DTIC
Computer Programs; Air Transportation; Human-Computer Interface; Graphical User Interface; Scheduling

19970016044 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Canberra, Australia
A Versatile Airborne Data Acquisition and Replay (VADAR) System
Holland, O. F., Defence Science and Technology Organisation, Australia; Harvey, J. F., Defence Science and Technology Organisation, Australia; Sutton, C. W., Defence Science and Technology Organisation, Australia; Aug. 1996; 44p; In English
Report No.(s): AD-A315135; DSTO-TR-0368; DODA-AR-009-751; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Versatile Airborne Data Acquisition and Replay (VADAR) system is described. This system was developed to meet the requirements of the Royal Australian Navy in conduct of flight trials with helicopters operating at sea from ships fitted with helicopter flight decks. VADAR is based upon a portable personal computer that mostly utilises commercially available hardware. The system is menu controlled by in-house developed programs that also provide quick-look and replay facilities.
DTIC
Data Acquisition; Flight Tests; Information Retrieval; Data Storage; Aircraft Equipment

19970016899 Massachusetts Univ., Computer Science Dept., Amherst, MA USA

Multi-Agent Reinforcement Learning and Adaptive Neural Networks ***Final Report, 1 Apr. 1993 - 30 Apr 1996***

Barto, Andrew G., Massachusetts Univ., USA; Aug. 08, 1996; 22p; In English

Contract(s)/Grant(s): F49620-93-1-0269

Report No.(s): AD-A315266; AFOSR-TR-96-0487; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This project investigated learning systems consisting of multiple interacting controllers, or agents: each of which employed a modern reinforcement learning method. The objective was to study the utility of reinforcement learning as an approach to complex decentralized control problems. The major accomplishment was a detailed study of multi-agent reinforcement learning applied to a large-scale decentralized stochastic control problem. This study included a very successful demonstration that a multi-agent reinforcement learning system using neural networks could learn high-performance dispatching of multiple elevator cars in a simulated multi-story building. This problem is representative of very large-scale dynamic optimization problems of practical importance that are intractable for standard methods. The performance achieved by the distributed elevator controller surpassed that of the best of the elevator control algorithms accessible in the literature, showing that reinforcement learning can be a useful approach to difficult decentralized control problems. Additional empirical results demonstrated the performance of reinforcement learning-systems in the setting of nonzero-sum games, with mixed results. Some progress was also made in improving theoretical understanding of multi-agent reinforcement learning.

DTIC

Approach Control; Controllers; Neural Nets

Subject Term Index

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