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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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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*

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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 358)

OCTOBER 3, 1997

01
AERONAUTICS

19970026150 Advisory Group for Aerospace Research and Development, Flight Vehicle Integration Panel, Neuilly-Sur-Seine, France

Helicopter/Weapon System Integration ***L'integration des systemes d'armes des helicopteres***

Jul. 1997; 184p; In English, 19-20 May 1997, Winchester, Athens, UK, Greece; Also announced as 19970026151 through 19970026159

Report No.(s): AGARD-LS-209; ISBN-92-836-1055-5; Copyright Waived; Avail: CASI; A09, Hardcopy; A02, Microfiche

This publication includes the papers presented in a NATO Advisory Group for Aerospace Research and Development (AGARD) Lecture Series. This Lecture Series considered the problems of integrating externally mounted weapons on helicopters. The focus is on aeromechanical and structural aspects, with additional discussion on operational issues. It addresses new aspects in the field of helicopter/weapon system integration; it places a strong emphasis on the lessons learned from recent experiences in actual development programs. The publication includes case histories of weapons integration on the AH-64 Apache, the RAH-66 Comanche, the EH-101, and the Tiger.

Author

Helicopters; Systems Integration; Weapon Systems

19970026151 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Flugmechanik, Brunswick, Germany

Overview

Gmelin, Bernd L., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Helicopter/Weapon System Integration; Jul. 1997; 6p; In English; Also announced as 19970026150; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The helicopter is fast approaching a half century of service as a weapon system. From humble beginnings after World War 2, largely in the roles of observation platforms and search and rescue vehicles, rotorcraft have evolved to a principal in the modern battle scenario. In the war at sea, the helicopter forms an integral part of a task force capable of launching devasting firepower at surface and subsurface targets. In the airland battle, technology has made the helicopter into a tank killer, troop transport and night observation platform. Finally, in the most unlikely arena, air-to-air combat, modern weaponry has shown the helicopter to be effective against even high performance tactical aircraft.

Derived from text

Helicopters; Combat; Weapon Systems; Rotary Wing Aircraft

19970026221 Defence Science and Technology Organisation, Airframes and Engines Div., Canberra, Australia

F-111C Lower Wing Skin Bonded Composite Repair Substantiation Testing

Boykett, R., Defence Science and Technology Organisation, Australia; Walker, K., Defence Science and Technology Organisation, Australia; Nov. 1996; 80p; In English

Report No.(s): AD-A324095; DSTO-TR-0480; DODA-AR-010-110; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Experimental testing was undertaken to verify a bonded composite repair to a crack in the primary structure of a F-111C aircraft of the Royal Australian Air Force. The flight safety was compromised by a crack in the lower wing skin reducing the structure residual strength below the Design Limit level. Two levels of representative specimens were designed to incorporate the complex local geometry in the lower wing skin. They were tested in several configurations (ambient, high and low temperature) under static and cyclic loads with, and without, repaired cracks. Extensive strain survey data was obtained for both types of specimens and their static residual strength was shown to be restored by the repair. Cyclic loading tests of specimens with the repair also demon-

strated good durability and damage tolerance, with crack growth data providing a recommended inspection interval for remaining aircraft
DTIC
Aircraft Maintenance; Wings; Crack Propagation; F-111 Aircraft; Composite Materials; Bonding; Residual Strength

02
AERODYNAMICS

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

19970026070 Army Natick Research and Development Command, MA USA
Predictive Model of a Parachute Retraction Soft Landing System ***Final Report, Apr. - Sep. 1995***
Krainski, Walter J., Jr., Army Natick Research and Development Command, USA; Apr. 1997; 58p; In English
Report No.(s): AD-A324641; NATICK/TR-97/014; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The U.S. Army Soldier Systems Command's Natick Research, Development and Engineering Center (NRDEC) is currently examining a novel concept for reducing the impact shock sustained by airdropped payloads upon ground impact A device, called a parachute retractor, is placed between the payload and parachute confluence point, and when activated, accelerates the parachute and payload toward each other; slowing the payload prior to ground impact. The goal is to eliminate the cushioning material currently placed under airdrop loads, providing a roll-on/roll-off (RO/RO) capability. The retractor concept consists of a pneumatically driven piston/cylinder mechanism connected by cables to upper and lower pulley blocks to increase the system's overall mechanical advantage. Full scale testing of payload/retractor combinations is considered impractical, given the varied weights of military cargo presently airdropped and the multitude of retractor configurations possible. The need for a computational tool to determine the activation height and to optimize system design parameters, therefore, was recognized early on in the exploratory development effort. This report describes a predictive model, developed in response to that need, which couples a simplified parachute model to a model of the retractor mechanism. This model is able to predict the motion of the piston, payload and parachute confluence point, as well as the forces generated during retraction. This report first reviews the model's underlying theory and method of coupling. Computer program predictions are then compared to behavior observed in an experiment conducted on a instrumented prototype retractor device at Tustin Marine Corps Air Station, Santa Ana, CA in April 1994.
DTIC
Airdrops; Soft Landing; Performance Prediction; Computerized Simulation; Parachute Descent; Mechanical Devices

19970026087 NASA Dryden Flight Research Center, Edwards, CA USA
Dynamic Ground Effect for a Cranked Arrow Wing Airplane
Curry, Robert E., NASA Dryden Flight Research Center, USA; Aug. 1997; 20p; In English; Atmospheric Flight Mechanics, 11-13 Aug. 1997, New Orleans, LA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 539-31-24
Report No.(s): NASA-TM-4799; NAS 1.15:4799; H-2177; AIAA Paper 97-3649; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flight-determined ground effect characteristics for an F-16XL airplane are presented and correlated with wind tunnel predictions and similar flight results from other aircraft. Maneuvers were conducted at a variety of flightpath angles. Conventional ground effect flight test methods were used, with the exception that space positioning data were obtained using the differential global positioning system (DGPS). Accuracy of the DGPS was similar to that of optical tracking methods, but it was operationally more attractive. The dynamic flight determined lift and drag coefficient increments were measurably lower than steady-state wind-tunnel predictions. This relationship is consistent with the results of other aircraft for which similar data are available. Trends in the flight measured lift increments caused by ground effect as a function of flightpath angle were evident but weakly correlated. An engineering model of dynamic ground effect was developed based on linear aerodynamic theory and super-positioning of flows. This model was applied to the F-16XL data set and to previously published data for an F-15 airplane. In both cases, the model provided an engineering estimate of the ratio between the steady-state and dynamic data sets.
Author
Aerodynamic Characteristics; Aerodynamics; F-15 Aircraft; F-16 Aircraft; Flight Tests; Supersonic Transports

19970026180 Carnegie-Mellon Univ., Dept. of Mechanical Engineering, Pittsburgh, PA USA
Numerical Study of Boundary-Layer in Aerodynamics ***Final Report, 1 Jan. 1994 - 31 Dec. 1996***
Shih, Tom I-P., Carnegie-Mellon Univ., USA; Jul. 21, 1997; 52p; In English
Contract(s)/Grant(s): NCC2-845
Report No.(s): NASA-CR-205075; NAS 1.26:205075; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The accomplishments made in the following three tasks are described: (1) The first task was to study shock-wave boundary-layer interactions with bleed - this study is relevant to boundary-layer control in external and mixed-compression inlets of supersonic aircraft; (2) The second task was to test RAAKE, a code developed for computing turbulence quantities; and (3) The third task was to compute flow around the Ames ER-2 aircraft that has been retrofitted with containers over its wings and fuselage. The appendices include two reports submitted to AIAA for publication.
Derived from text
Boundary Layer Flow; Boundary Layer Control; Computational Fluid Dynamics; Computer Programs; Aerodynamics

19970026365 Advisory Group for Aerospace Research and Development, Fluid Dynamics Panel, Neuilly-Sur-Seine, France
Capsule Aerothermodynamics ***L'Aerothermodynamique des Capsules***
Capsule Aerothermodynamics; May 1995; 296p; In English, 20-22 Mar. 1995, Rhode-Saint-Genese, Belgium; Also announced as 19970026366 through 19970026379
Report No.(s): AGARD-R-808; ISBN-92-836-1053-9; Copyright Waived; Avail: CASI; A13, Hardcopy; A03, Microfiche

Lecture notes for the AGARD Fluid Dynamics Panel (FDP) Special Course on 'Capsule Aerothermodynamics' have been assembled in this report. Aerodynamic design aspects related to planetary probe and capsule configurations are covered, as well as critical phenomena occurring during the different regimes of flight. The impact of real gas and rarefaction on capsule aerothermodynamics, and in particular on forebody and wake flow, is addressed. The material assembled in this report was prepared under the combined sponsorship of the AGARD Fluid Dynamics Panel, the Consultant and Exchange Program of AGARD, and the von Karman Institute (VKI) for Fluid Dynamics.
Author
Aerothermodynamics; Heat Transfer; Space Probes; Hypersonic Flow; Space Capsules; Aerodynamics; Lectures; Rarefied Gas Dynamics; Rarefaction

19970026366 European Space Agency. European Space Research and Technology Center, ESTEC, Aerothermodynamic Section, Noordwijk, Netherlands
Capsule Aerothermodynamics: Missions, Critical Issues Overview and Course Roadmap
Muylaert, Jean, European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; Capsule Aerothermodynamics; May 1995; 24p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

At present, on a world scale, different capsules and penetrators are being considered for planetary entry such as the Huygens probe to Titan, the Intermarsnet to Mars, and the Mercury orbiter probe to Venus. In addition conceptual studies for earth reentry are in progress for crew transport vehicles. Their geometries vary from low lift to drag ratio Apollo type to more advanced and complex bent biconic high lift to drag configurations. Because of the renewed interest in Capsule Aerothermodynamics, this course is organized to stimulate research in this field for young engineers as well as to update expertise for more experienced aerodynamicists. The course will cover all aerodynamic design aspects related to planetary probe and capsule configurations. Critical phenomena occurring during the different regimes of flight from the rarefied through the hypersonic, supersonic, transonic and subsonic portions of flight will be reviewed. The impact of real gas and rarefaction on capsule aerothermodynamics and in particular on forebody and wake flows will be addressed. In addition present day computational and experimental capabilities to assess radiation, blackout, ablation and the characterization of the dynamic derivatives will be discussed.
Author
Aerodynamic Configurations; Aerothermodynamics; Hypersonics; Real Gases; Rarefaction; Space Capsules; Interplanetary Spacecraft; Forebodies; Aerodynamics; Spacecraft Design

19970026370 NASA Langley Research Center, Hampton, VA USA
Rarefied Flows of Planetary Entry Capsules
Moss, James N., NASA Langley Research Center, USA; May 1995; 34p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The impact of rarefaction on entry capsules and spacecraft aerothermodynamics is emphasized for various aeroassist missions. The capability of the direct simulation Monte Carlo (DSMC) method to simulate such flows is demonstrated through exam-

ples of validation studies and applications. Several space flight projects and ground-based experiments are reviewed for which rarefaction effects have significant effect on spacecraft performance or experimental measurements. This review clearly demonstrates the significant role that the DSMC method plays in characterizing such flows.
Author
Computerized Simulation; Computational Fluid Dynamics; Atmospheric Entry; Monte Carlo Method; Aerothermodynamics; Aeroassist; Rarefied Gas Dynamics; Space Capsules; Hypersonic Flow; Rarefaction; Interplanetary Spacecraft

19970026371 NASA Ames Research Center, Moffett Field, CA USA
Real Gas: CFD Prediction Methodology Flow Physics for Entry Capsule Mission Scenarios
Deiwert, George S., NASA Ames Research Center, USA; May 1995; 10p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Mission and concept studies for space exploration are described for the purpose of identifying flow physics for entry capsule mission scenarios. These studies are a necessary precursor to the development and application of CFD prediction methodology for capsule aerothermodynamics. The scope of missions considered includes manned and unmanned cislunar missions, missions to the minor planets, and missions to the major planets and other celestial objects in the solar system.
Author
Aerothermodynamics; Real Gases; Computational Fluid Dynamics; Space Capsules; Space Exploration; Prediction Analysis Techniques; Atmospheric Entry; Interplanetary Spacecraft; Spacecraft Design; Interplanetary Flight

19970026372 NASA Ames Research Center, Moffett Field, CA USA
Data Base for CFD Validation
Deiwert, George S., NASA Ames Research Center, USA; May 1995; 16p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The flow behind the shock wave formed around objects which fly at hypervelocity behaves differently from that of a perfect gas. Molecules become vibrationally excited, dissociated, and ionized. The hot gas may emit or absorb radiation. When the atoms produced by dissociation reach the wall surface, chemical reactions, including recombination, may occur. The thermochemical phenomena of vibration, dissociation, ionization, surface chemical reaction, and radiation are referred to commonly as high-temperature real-gas phenomena. The phenomena cause changes in the dynamic behavior of the flow and the surface pressure and heat transfer distribution around the object. The character of a real gas is described by the internal degrees of freedom and state of constituent molecules; nitrogen and oxygen for air. The internal energy states, rotation, vibration and electronic, of the molecules are excited and, in the limit, the molecular bonds are exceeded and the gas dissociated into atomic and, possibly, ionic constituents. The process of energy transfer causing excitation, dissociation and recombination is a rate process controlled by particle collisions. Binary, two-body, collisions are sufficient to cause internal excitation, dissociation and ionization while three-body collisions are required to recombine the particles into molecular constituents. If the rates of energy transfer are fast with respect to the local fluid dynamic time scale the gas is in, or nearly in, equilibrium. If the energy transfer rates are very slow the gas can be described as frozen. In all other instances, wherein any of the energy exchange rates are comparable to the local fluid time scale, the gas will be thermally or chemically reacting and out of equilibrium. Real gas thermochemical nonequilibrium processes are important in the determination of aerodynamic heating; both convective (including wall catalytic effects) and radiative heating. to illustrate this we consider the hypervelocity flow over a bluff body typical of an atmospheric entry vehicle or an aerospace transfer vehicle (ASTV). The qualitative aspects of a hypersonic flow field over a bluff body are discussed in two parts, forebody and afterbody, with attention to which particular physical effects must be included in an analysis. This will indicate what type of numerical modeling will be adequate in each region of the flow. A bluff forebody flow field is dominated by the presence of the strong bow shock wave and the consequent heating, and chemical reaction of the gas. At high altitude hypersonic flight conditions the thermal excitation and chemical reaction of the gas occur slowly enough that a significant portion of the flow field is in a state of thermochemical nonequilibrium. A second important effect is the presence of the thick boundary layer along the forebody surface. In this region there are large thermal and chemical species gradients due to the interaction of the gas with the wall. Also at high altitudes the shock wave and the boundary layer may become so thick that they merge; in this case the entire shock layer is dominated by viscous effects.
Author
Aerodynamic Heating; Aerospace Vehicles; Afterbodies; Atmospheric Entry; Bluff Bodies; Data Bases; Energy Transfer; Flight Conditions; Forebodies; Heat Transfer; High Temperature Gases; Hypersonic Flight; Internal Energy; Shock Waves; Computational Fluid Dynamics

19970026373 Aerospatiale, Dept. Aerodynamique and Electromagnetisme, Les Mureaux, France

Blunt Bodies Dynamic Derivatives

Baillion, M., Aerospatiale, France; May 1995; 28p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This document addresses the aerodynamic damping coefficients of capsules and planetary entry probes. First, the general item of dynamic coefficients will be described, and the specificity of large drag, blunted shapes will be described. A tentative description of the dynamic instability of the capsule type shapes will be shown. This dynamic instability has strong consequences at system level, in the frame of the development phase of both capsules and planetary entry probes, which will then be depicted. The determination of the dynamic coefficients will be addressed, both by theoretical and experimental ways. Finally, the HUYGENS entry module case will be detailed.

Author

Atmospheric Entry; Space Capsules; Space Probes; Blunt Bodies; Aerodynamic Coefficients; Dynamic Stability; Oscillation Dampers; Hypersonic Wakes; Uncontrolled Reentry (Spacecraft); Dynamic Control

19970026374 Aerospatiale, Dept. Aerodynamique and Electromagnetisme, Les Mureaux, France

Radiative Heat Flux: Theoretical and Experimental Predictions for Titan Entry Probe

Baillion, M., Aerospatiale, France; Taquin, G., Aerospatiale, France; May 1995; 30p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This document presents the rationale of radiative heat flux predictions which were performed in the frame of the HUYGENS probe project. Due to the particular nature of TITAN atmosphere. associated to the entry velocity of the probe, the radiative heat flux is almost half of the total heat flux. In the thermal protection design process, accurate radiative heat flux calculations are needed in order to design a secured environment for onboard experiments, while mass penalties of thermal protection must be avoided. This document describes the theoretical and experimental investigations of the radiative heat fluxes which were performed in the frame of the HUYGENS program.

Author

Huygens Probe; Titan; Heat Flux; Aerodynamic Heating; Aerothermodynamics; Radiative Heat Transfer; Hypersonic Flow; Forebodies; Shock Layers; Atmospheric Entry; Thermal Protection

19970026379 Aerospatiale, Dept. Aerodynamique and Electromagnetisme, Les Mureaux, France

Aerothermodynamic Requirements and Design of the Huygens Probe

Baillion, M., Aerospatiale, France; May 1995; 28p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper presents the relationship between the main system requirements of the HUYGENS probe, derived either from mission analysis or from experiment related requirements, to the aerodynamics and aerothermodynamics studies. The first part of the document will present the main mission and experiment related requirements, as they are expressed at the very beginning of the project, and which are derived from the specificity of the mission, without any direct link with aerothermodynamics. The general system requirements of the HUYGENS probe, are the ones which are expressed by the customer ESA towards the industrial prime contractor Aerospatiale Space & Defense, and which correspond to the elementary requirements of feasibility of the mission, in terms of general objective: reach TITAN, survive a 7 years cruise in deep space, survive to the hypersonic entry in TITAN atmosphere. The second part will show how these very general requirements are translated in terms of aerothermodynamics requirements. The third part will show how these aerothermodynamics requirements are implemented in general aerothermodynamics studies and test plan, which has been actually performed in the frame of the HUYGENS project. The choice of the shapes, the Computational Fluid Dynamics (CFD) and test plan, the related CFD and wind tunnel specificity and difficulties are addressed. The need for characterisation of the convective and radiative heat fluxes in an unknown environment is shown. Finally very specific items like contamination and spin device are addressed.

Author

Aerothermodynamics; Convective Heat Transfer; Huygens Probe; Hypersonics; Computational Fluid Dynamics; Aerodynamics; Aerodynamic Heating; Hypersonic Reentry

19970026595 NASA Ames Research Center, Moffett Field, CA USA

System and Method for Modeling the Flow Performance Features of an Object

Jorgensen, Charles, Inventor, NASA Ames Research Center, USA; Ross, James, Inventor, NASA Ames Research Center, USA; Jul. 15, 1997; 14p; In English

Patent Info.: Filed 19 May 1995; NASA-Case-ARC-14008-1; US-Patent-5,649,064; US-Patent-Appl-SN-446071; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

The method and apparatus includes a neural network for generating a model of an object in a wind tunnel from performance data on the object. The network is trained from test input signals (e.g., leading edge flap position, trailing edge flap position, angle of attack, and other geometric configurations, and power settings) and test output signals (e.g., lift, drag, pitching moment, or other performance features). In one embodiment, the neural network training method employs a modified Levenberg-Marquardt optimization technique. The model can be generated 'real time' as wind tunnel testing proceeds. Once trained, the model is used to estimate performance features associated with the aircraft given geometric configuration and/or power setting input. The invention can also be applied in other similar static flow modeling applications in aerodynamics, hydrodynamics, fluid dynamics, and other such disciplines. For example, the static testing of cars, sails, and foils, propellers, keels, rudders, turbines, fins, and the like, in a wind tunnel, water trough, or other flowing medium.

Official Gazzette of the U.S. Patent and Trademark

Neural Nets; Wind Tunnel Tests; Real Time Operation; Models; Aerodynamics; Performance Prediction

19970026878 Virginia Polytechnic Inst. and State Univ., Dept. of Mechanical Engineering, Blacksburg, VA USA

Aerodynamic Shape Sensitivity Analysis and Design Optimization of Complex Configurations Using Unstructured Grids

Taylor, Arthur C., III, Old Dominion Univ., USA; Newman, James C., III, Virginia Polytechnic Inst. and State Univ., USA; Barnwell, Richard W., Virginia Polytechnic Inst. and State Univ., USA; Jun. 25, 1997; 12p; In English; 15th; Applied Aerodynamics, 23-25 Jun. 1997, Atlanta, GA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAG1-1265; NGT-51247

Report No.(s): NASA-CR-204767; NAS 1.26:204767; AIAA Paper 97-2275; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

A three-dimensional unstructured grid approach to aerodynamic shape sensitivity analysis and design optimization has been developed and is extended to model geometrically complex configurations. The advantage of unstructured grids (when compared with a structured-grid approach) is their inherent ability to discretize irregularly shaped domains with greater efficiency and less effort. Hence, this approach is ideally suited for geometrically complex configurations of practical interest. In this work the nonlinear Euler equations are solved using an upwind, cell-centered, finite-volume scheme. The discrete, linearized systems which result from this scheme are solved iteratively by a preconditioned conjugate-gradient-like algorithm known as GMRES for the two-dimensional geometry and a Gauss-Seidel algorithm for the three-dimensional; similar procedures are used to solve the accompanying linear aerodynamic sensitivity equations in incremental iterative form. As shown, this particular form of the sensitivity equation makes large-scale gradient-based aerodynamic optimization possible by taking advantage of memory efficient methods to construct exact Jacobian matrix-vector products. Simple parameterization techniques are utilized for demonstrative purposes. Once the surface has been deformed, the unstructured grid is adapted by considering the mesh as a system of interconnected springs. Grid sensitivities are obtained by differentiating the surface parameterization and the grid adaptation algorithms with ADIFOR (which is an advanced automatic-differentiation software tool). to demonstrate the ability of this procedure to analyze and design complex configurations of practical interest, the sensitivity analysis and shape optimization has been performed for a two-dimensional high-lift multielement airfoil and for a three-dimensional Boeing 747-200 aircraft.

Author

Parameterization; Optimization; Finite Volume Method; Differential Equations; Conjugate Gradient Method; Aerodynamic Configurations; Boeing 747 Aircraft

03
AIR TRANSPORTATION AND SAFETY

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

19970026154 Westland Helicopters Ltd., Yeovil, UK

Store Separation

McBeath, J. R. B., Westland Helicopters Ltd., UK; Jul. 1997; 20p; In English; Also announced as 19970026150; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The safe separation of a store from any aircraft represents potentially the most hazardous phase of the store release process. The paper examines in turn the various mechanical and aerodynamic influences that come into play during store separation, re-

views the requirements imposed by national standards, and explores how modeling and instrumentation techniques have advanced to benefit programs that include verification of safe store separation.
Derived from text
Helicopters; Military Helicopters; Rotary Wing Aircraft; External Store Separation; Flight Characteristics

19970026193 Federal Aviation Administration, Airport and Aircraft Safety Research and Development Div., Atlantic City, NJ USA
A Study of the Continued Fire Worthiness of Aircraft Seat Cushion Fire-Blocking Layers ***Final Report***
Ingerson, Doug, Federal Aviation Administration, USA; Mar. 1997; 30p; In English
Report No.(s): AD-A325356; DOT/FAA/AAR-422; DOT/FAA/AR-95/49; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The continued fire endurance of fire-blocked aircraft seat cushions after service wear and tear was evaluated based on in-service examinations performed on commercial aircraft and sample testing of donated cushions per the oil burner test contained in Part 25, Appendix F, Part 2 of the Federal Aviation Regulations. A total of 176 examinations took place onboard aircraft to evaluate the condition of the in-service aircraft seats. A comparison was made between the observed conditions of the in-service seat cushions and the 38 used seat cushion sets that were donated for this project. The comparison indicated that the donated used aircraft cushion sets were representative of actual in-service conditions. The donated cushion sets were then evaluated for continued fire worthiness with the aircraft cushion oil burner test. Eight pairs were retained in stock condition and the remaining 30 pairs were altered to a 'modified' test configuration. The test results included the weight loss profile for each cushion set burnt. The test results indicated that there were no significant fire endurance problems with the fire-blocking materials that were composed of Keviar, Nomex, and/or polybenzimidazole (PBI) components.
DTIC
Aircraft Compartments; Seats; Commercial Aircraft; Performance Tests; Fires; Aircraft Safety

19970026207 Air Weather Service, Aerospace Sciences Div., Scott AFB, IL USA
FYI: Icing, No. 38
Larabee, Salinda, Air Weather Service, USA; Mar. 1997; 19p; In English
Report No.(s): AD-A324098; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Icing is responsible for numerous aircraft accidents and in-flight emergencies each year. One drastic example was the 1994 commuter aircraft crash in Roselawn, Indiana, which killed 68 people. Icing was directly responsible for this tragedy. When ice forms on an aircraft, it distorts the aerodynamic shape of lifting surfaces, resulting in degraded, if not total loss of aircraft control. Accurate icing forecasts are extremely important to each aircrew. This FYI is a refresher on icing and its effects on aviation, along with a review of icing analysis and forecasting techniques.
DTIC
Aircraft Accidents; Commuter Aircraft; Crashes; Ice Formation; Aircraft Control; Aircraft Icing; Aerodynamic Configurations; Forecasting

19970026243 Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA
A Field Evaluation of Data Link Flight Information Services for General Aviation Pilots ***Final Report***
Talotta, Nicholas J., NTI, Inc., USA; Feb. 1997; 72p; In English
Report No.(s): AD-A325338; DOT/FAA/CT-97/3; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report presents an analysis of results that were obtained from a field evaluation of Data Link Flight Information Services designed for use by general aviation pilots. The goal of the report is to provide an independent assessment of the field evaluation based on an analysis of the formal AOPA/ASF structured evaluation results and on direct observations made during data collection site visits.
DTIC
Evaluation; Data Links; Information Systems; Flight Characteristics; Data Acquisition

19970026388 Defence Research Agency, Systems Integration Dept., Farnborough, UK
Audio Warnings for Military Aircraft
James, S. H., Defence Research Agency, UK; Jun. 1997; 20p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

A survey of warning systems currently installed in military aircraft showed that generally they are of poor design. Simply constructed warning sounds have been added to aircraft as and when deemed necessary and hence, have been installed on an indi-

vidual basis rather than as an integrated warning set. As more and more of these types of sounds are introduced discrimination will become more difficult and confusions increase. Additionally, the warnings are continuous in nature and presented at too high a volume which not only causes startle but interferes with communications, resulting in aircrew seeking the audio mute rather than dealing with the problem at hand. Consequently, the audio warnings currently in use may prove counterproductive and have flight safety implications. This paper details the research conducted by DRA aimed at providing the UK military aircraft fleet with a standardised, fully integrated audio warning suite. to date the work has culminated in the development of a set of design guidelines and a presentation strategy that not only minimizes the number of warning sounds required in a warning set but that remains flexible to allow new warnings to be added without necessarily increasing the number of sounds required. The characteristics for trend indicating sounds are also defined and a protocol for their design detailed. Additionally, in an attempt to enhance the number of audio alerts aircrew can process, manage and respond to accurately, the feasibility of mapping aircraft threat related warnings in three dimensional space is discussed and future research areas detailed.
Author
Warning Systems; Flight Crews; Workloads (Psychophysiology); Audio Equipment; Auditory Perception; Auditory Signals

19970026389 MRC Applied Psychology Unit, Cambridge, UK
Extending the Frequency Range of Existing Auditory Warnings
Patterson, R. D., MRC Applied Psychology Unit, UK; Datta, A. J., MRC Applied Psychology Unit, UK; Jun. 1997; 8p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper discusses two projects involving auditory warnings in military helicopters and fixed-wing aircraft. The first project reports methods to increase the frequency range of the existing DRA auditory warnings without changing their sound quality. The need to extend the frequency range arose from the requirement for 'out-of-head' localization of warning sounds. In the second project, the purpose was to develop a new class of sounds to be used as threat warnings. The aim was to make threat warnings that had a distinct sound quality as a set but which were, at the same time, separately identifiable.
Author
Warning Systems; Audio Frequencies; Auditory Perception; Frequency Ranges; Military Helicopters; Fixed Wings; Sound Localization

19970026942 Armstrong Lab., Clinical Sciences Div., Brooks AFB, TX USA
A Human Factors Guide for Consultants to USAF Aircraft Mishap Investigations
King, Raymond E., Armstrong Lab., USA; Callister, Joseph D., Armstrong Lab., USA; Patterson, John C., Armstrong Lab., USA; Sipes, Walter E., Armstrong Lab., USA; Apr. 1997; 27p; In English
Report No.(s): AD-A324960; AL/AO-SR-1997-0001; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This guide is a pragmatic handbook for human factors consultants to Safety Investigation Boards convened to investigate USA Air Force aircraft mishaps. It describes the process of being identified to consult to a mishap investigation (safety) board, methods of collecting and analyzing data, and suggestions for interacting effectively with mishap board members. Interviewing receives extensive treatment. Readers are given, in an appendix, a suggested 'crash kit' to better prepare them to be effective consultants. The USAF School of Aerospace Medicine Aircraft Mishap Investigation and Prevention course is outlined in an appendix.
DTIC
Human Factors Engineering; Aerospace Medicine; Aircraft Accidents; Crashes; Safety Management; Handbooks

19970027072 NASA Ames Research Center, Moffett Field, CA USA
Detecting Tooth Damage in Geared Drive Trains
Nachtsheim, Philip R., NASA Ames Research Center, USA; Aug. 1997; 10p; In English
Contract(s)/Grant(s): RTOP 519-30-12
Report No.(s): NASA-TM-112207; NAS 1.15:112207; A-977138; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper describes a method that was developed to detect gear tooth damage that does not require a priori knowledge of the frequency characteristic of the fault. The basic idea of the method is that a few damaged teeth will cause transient load fluctuations unlike the normal tooth load fluctuations. The method attempts to measure the energy in the lower side bands of the modulated signal caused by the transient load fluctuations. The method monitors the energy in the frequency interval which excludes the frequency of the lowest dominant normal tooth load fluctuation and all frequencies above it. The method reacted significantly to the tooth fracture damage results documented in the Lewis data sets which were obtained from tests of the OH-58A transmission

and tests of high contact ratio spiral bevel gears. The method detected gear tooth fractures in all four of the high contact ratio spiral bevel gear runs. Published results indicate other detection methods were only able to detect faults for three out of four runs.
Author
Gear Teeth; Gears; Fractures (Materials); Detection; Damage

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

19970026109 Cincinnati Univ., Dept. of Aerospace Engineering and Engineering Mechanics, OH USA
Departure Trajectory Synthesis and the Intercept Problem
Bolender, Michael A., Cincinnati Univ., USA; Slater, G. L., Cincinnati Univ., USA; Jul. 07, 1997; 18p; In English; Guidance, Navigation and Control, 11-13 Aug. 1997, New Orleans, LA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NCC2-950; NGT2-52205
Report No.(s): NASA-CR-205005; NAS 1.26:205005; Rept-ADC-97-3; AIAA Paper 97-3545; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Two areas of the departure problem in air traffic control are discussed. The first topic is the generation of climb-out trajectories to a fix. The trajectories would be utilized by a scheduling algorithm to allocate runways, sequence the proposed departures, and assign a departure time. The second area is concerned with finding horizontal trajectories to merge aircraft from the TRACON to an open slot in the en-route environment. Solutions are presented for the intercept problem for two cases: (1) the aircraft is traveling at the speed of the aircraft in the jetway, (2) the merging aircraft has to accelerate to reach the speed of the aircraft in the en-route stream. An algorithm is given regarding the computation of a solution for the latter case. For the former, a set of equations is given that allows us to numerically solve for the coordinate where the merge will occur.
Author
Trajectories; Air Traffic Control; Algorithms; Climbing Flight

19970026238 NASA Pasadena Office, CA USA
Global Positioning System Antenna Fixed Height Tripod Adapter
Dinardo, Steven J., NASA Pasadena Office, USA; Smith, Mark A., NASA Pasadena Office, USA; Mar. 25, 1997; 11p; In English; Continuation of abandoned US-Patent-Appl-SN-265521, filed 21 Jun. 1994
Patent Info.: Filed 24 Jul. 1996; NASA-Case-NPO-18919-2-CU; US-Patent-5,614,918; US-Patent-Appl-SN-686137; US-Patent-Appl-SN-265521; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An improved Global Positioning em antenna adaptor allows fixed antenna height measurements by removably attaching an adaptor plate to a conventional surveyor's tripod. Antenna height is controlled by an antenna boom which is a fixed length rod. The antenna is attached to one end of the boom. The opposite end of the boom tapers to a point sized to fit into a depression at the center of survey markers. The boom passes through the hollow center of a universal ball joint which is mounted at the center of the adaptor plate so that the point of the rod can be fixed in the marker's central depression. The mountains of the ball joint allow the joint to be moved horizontally in any direction relative to the tripod. When the ball joint is moved horizontally, the angle between the boom and the vertical changes because the boom's position is fixed at its lower end. A spirit level attached to the rod allows an operator to determine when the boom is plumb. The position of the ball joint is adjusted horizontally until the boom is plumb. At that time the antenna is positioned exactly over the center of the monument and the elevation of the antenna is precisely set by the length of the boom.
Author
Global Positioning System; Tripods; Joints (Junctions); Adapters

19970026432 Advanced Research Projects Agency, Tactical Technology Office, Arlington, VA USA
Results of Global Positioning System Guidance Package (GGP) Technology Demonstration
Kaspar, B., Air Force Systems Command, Bolling AFB, USA; Aein, J., RAND Corp., USA; Killen, A., Army Missile Command, USA; Dahlen, N., Litton Guidance and Control Systems, USA; Jun. 1997; 12p; In English; Also announced as 19970026418; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The Advanced Research Projects Agency (ARPA) began a program in May 1983 to demonstrate the necessary solid-state technologies to miniaturize full military precision (P/Y) GPS receivers. The 'Virginia Slims' miniature GPS receiver (MGR) pro-

gram was successfully completed in December 1989 with the demonstration of an MGR the size of a cigarette package. Military products derived from the 'Virginia Slims' MGR chip set include the Tomahawk Land Attack Missile GPS receiver, the Precision Location GPS Receiver (PLGR), and the Miniature Airborne GPS Receiver (MAGR), as well as several commercial GPS engines.
Derived from text
Global Positioning System; Miniaturization; Chips (Electronics); Integrated Circuits

19970026886 Army Research Lab., Adelphi, MD USA
Correlations between Global Positioning System and U.S. Naval Observatory Master Clock Time ***Final Report, Nov. 1995 - May 1997***
Bahder, Thomas B., Army Research Lab., USA; Jun. 1997; 35p; In English
Report No.(s): AD-A326252; ARL-TR-1282; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The U.S. Naval Observatory Master Clock is used to steer Global Positioning System (GPS) time. Time transfer data consisting of the difference between the Master Clock time and the GPS time were recorded from all satellites in the GPS constellation over a time period covering 10 October to 12 December 1995. A Fourier analysis of these data shows a distinct peak in the Fourier spectrum, corresponding approximately to a one day period. For a more accurate determination of this period, correlations are computed between successive days of data. An average of 25 correlation functions shows a correlation equal to 0.52 at a delay time of 23 hr 56 min (which corresponds to twice the average GPS satellite period). This correlation indicates that GPS time, as measured by the U.S. Naval Observatory, is periodic with respect to the Master Clock, with a period of 23 hr and 56 min. An autocorrelation of a five day segment of data indicates that these correlations persist for four successive days.
DTIC
Global Positioning System; Time Signals; Atomic Clocks; Autocorrelation

19970026944 Lockheed Martin Engineering and Sciences Co., Hampton, VA USA
W-Band Free Space Permittivity Measurement Setup for Candidate Radome Materials
Fralick, Dion T., Lockheed Martin Engineering and Sciences Co., USA; Aug. 1997; 12p; In English
Contract(s)/Grant(s): NAS1-96014; RTOP 522-33-11-04
Report No.(s): NASA-CR-201720; NAS 1.26:201720; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a measurement system used for w-band complex permittivity measurements performed in NASA Langley Research Center's Electromagnetics Research Branch. The system was used to characterize candidate radome materials for the passive millimeter wave (PMMW) camera experiment. The PMMW camera is a new technology sensor, with goals of all-weather landings of civilian and military aircraft. The sensor is being developed under a NASA Technology Reinvestment program with TRW, McDonnell- Douglas, Honeywell, and Composite Optics, Inc. as participants. The experiment is scheduled to be flight tested on the Air Force's 'Speckled Trout' aircraft in late 1997. The camera operates at W-band, in a radiometric capacity and generates an image of the viewable field. Because the camera is a radiometer, the system is very sensitive to losses. Minimal transmission loss through the radome at the operating frequency, 89 GHz, was critical to the success of the experiment. This paper details the design, set-up, calibration and operation of a free space measurement system developed and used to characterize the candidate radome materials for this program.
Author
Permittivity; Frequencies; Millimeter Waves; Radome Materials; Radomes; Radiometers; Electromagnetism; Calibrating

19970027049 Civil Aeromedical Inst., Training and Organizational Research Lab., Oklahoma City, OK USA
Designing Selection Tests for the Future National Airspace System Architecture ***Final Report***
Broach, Dana, Civil Aeromedical Inst., USA; Aug. 1997; 14p; In English
Report No.(s): DOT/FAA-AM-97/19; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Empirical data describing the mix of human abilities required to operate and maintain the future National Airspace System (NAS) architecture are presently lacking. A research program is proposed to develop the scientific tools and collect data to describe and assess the mix of abilities likely to be required of future Federal Aviation Administration air traffic control specialists, electronics technicians, and transportation system specialists. The first phase of the proposed research program is to develop a baseline profile describing the skills, abilities, and knowledge required to use, operate, and maintain the current NAS architecture. The second phase of the program is to develop and apply scientific tools to identify changes in personnel selection requirements in parallel with air traffic control and maintenance systems development. The third step in the research program is to develop, validate, and deliver new personnel selection technologies to reflect the human ability and performance needs of the future NAS architecture. The research program is designed to provide agency managers with the selection tools needed to manage personnel

costs, inevitable generational change in the technical workforces, and technological innovation in air traffic control and maintenance systems.
Author
Air Traffic Control; Air Traffic Controllers (Personnel); Human Performance; Systems Engineering; Research and Development

19970027096 Naval Surface Warfare Center, Warfare Analysis and Systems Dept., Dahlgren, VA USA
WGS 84 Coordinate Validation and Improvement for the NIMA and Air Force GPS Tracking Stations ***Final Report***
Cunningham, James, Naval Surface Warfare Center, USA; Curtis, Virginia L., Naval Surface Warfare Center, USA; Nov. 1996; 33p; In English
Report No.(s): AD-A326324; NSWCDD/TR-96/201; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using 10 days of Global Positioning System (GPS) pseudorange and carrier phase data collected in 1995 from 31 stations and 24 Block 2/2A satellites, estimates of GPS clocks, orbits, and tracking station coordinates were generated. The 31 sites consisted of the 12 National Imagery and Mapping Agency (NIMA) and Air Force operational stations, an additional NIMA site at Holloman Air Force Base, and 18 International GPS Service for Geodynamics (IGS) Rogue receiver sites. Ten of the NIMA and Air Force operational sites had their coordinates previously determined using GPS data. The results of this work suggest that the estimated 10 cm, one sigma, per component accuracy indicated for these 10 stations was conservative. The new World Geodetic System 1984 (WGS 84) coordinates generated for the 12 NIMA and Air Force operational stations are reported at the 1994.0 and 1997.0 epochs. The estimated accuracy of the new coordinates is better than 5 cm, one sigma, per component. Orbits estimated using the new WGS 84 coordinates agree better with the IGS final combined orbits, derived in the International Earth Rotation Service Terrestrial Reference Frame 1994, than or bits estimated using the old coordinates. The overall rms orbit-URE of the new orbits is estimated to be 12 cm, an improvement of 2 cm rms over the old orbits. Systematic differences with respect to the IGS orbits have been significantly reduced.
DTIC
Global Positioning System; Geodynamics; Geodesy; Earth Rotation; Imagery

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970026102 NASA Langley Research Center, Hampton, VA USA
Quasi-Static and Dynamic Response Characteristics of F-4 Bias-Ply and Radial-Belted Main Gear Tires
Davis, Pamela A., NASA Langley Research Center, USA; Feb. 1997; 44p; In English
Contract(s)/Grant(s): RTOP 505-63-10-02
Report No.(s): NASA-TP-3586; NAS 1.60:3586; L-17433; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An investigation was conducted at Langley Research Center to determine the quasi-static and dynamic response characteristics of F-4 military fighter 30x11.5-14.5/26PR bias-ply and radial-belted main gear tires. Tire properties were measured by the application of vertical, lateral, and fore-and-aft loads. Mass moment-of-inertia data were also obtained. The results of the study include quasi-static load-deflection curves, free-vibration time-history plots, energy loss associated with hysteresis, stiffness and damping characteristics, footprint geometry, and inertia properties of each type of tire. The difference between bias-ply and radial-belted tire construction is given, as well as the advantages and disadvantages of each tire design. Three simple damping models representing viscous, structural, and Coulomb friction are presented and compared with the experimental data. The conclusions discussed contain a summary of test observations.
Author
F-4 Aircraft; Aircraft Tires; Loads (Forces); Static Characteristics; Moments of Inertia; Dynamic Response; Footprints

19970026152 Boeing Sikorsky Joint Program Office, Philadelphia, PA USA
Performance
Harper, William H., Boeing Sikorsky Joint Program Office, USA; Jul. 1997; 14p; In English; Also announced as 19970026150; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

Power margin is a standard measure of helicopter performance. However, in the competitive market place of today, performance is also an economic measure--cost to operate. Engine technology has significantly reduced fuel consumption and advances in composite technologies have produced lightweight structures. External weapons increase an armed helicopters parasite drag by 40% to 50%. Drag reduction is, therefore, the next largest contribution to fuel savings with figure-of-merit and rotor lift/effec-

tive drag ratio improvement the next two important areas. This paper explores the advances made in rotor blade design technologies following the UH-60 and Apache. The performance of an advanced airfoil rotor design is compared to the UH-60 and other existing helicopters to quantify the advancements. The methodology and analytical tools used to predict the performance of the advanced airfoil rotor is completely described. The resulting rotor system is then used to examine a number of options selected to reduce the drag contribution of external stores.
Derived from text
Helicopter Performance; Lift Drag Ratio; Rotor Lift; Airfoils

19970026153 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Flugmechanik, Brunswick, Germany
Handling Qualities
Gmelin, Bernd L., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Jul. 1997; 22p; In English; Also announced as 19970026150; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The mission performance of an armed helicopter does not only depend on its weapon system's efficiency. Other factors like the helicopter performance and in particular the handling qualities of the overall helicopter/weapon system may significantly affect mission performance. Since handling qualities cover a wide range of aspects which sometimes are difficult to quantify, it is useful to refer to existing standards when defining armed helicopters specifications.
Derived from text
Helicopter Performance; Controllability; Maneuverability; Flight Characteristics; Helicopters

19970026155 Eurocopter Deutschland G.m.b.H., Technical Group TIGER, Munich, Germany
Loads, Dynamics/Vibrations, Acoustics
Wennekers, R., Eurocopter Deutschland G.m.b.H., Germany; Jul. 1997; 40p; In English; Also announced as 19970026150; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

Loads, dynamics/vibrations mechanics and acoustics are on one side classical disciplines which contribute to the integral helicopter layout. However in the context of weapon system integration they are the key areas where direct interfacing problems may arise between the basic helicopter and e.g. an external weapon store or a sight system.
Derived from text
Helicopters; Helicopter Performance; Vibration; Systems Integration; Loads (Forces); Acoustics

19970026157 Boeing Sikorsky Joint Program Office, Philadelphia, PA USA
RAH-66 Comanche Case History
Harper, William H., Boeing Sikorsky Joint Program Office, USA; Jul. 1997; 24p; In English; Also announced as 19970026150; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

Combat helicopters perform two basic missions: attack and reconnaissance. The mobility, situational awareness, and firepower that combat helicopters provide ground forces was well demonstrated during the Vietnam War. Operation Desert Storm provided a glimpse of modern nonlinear, close combat, coalition warfare and reinforced the importance of advanced technology combat equipment.
Derived from text
Helicopters; Reconnaissance; Combat; Ground Resonance; Military Helicopters

19970026158 Westland Helicopters Ltd., Yeovil, UK
EH101
McBeath, J. R. B., Westland Helicopters Ltd., UK; Jul. 1997; 14p; In English; Also announced as 19970026150; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The EH101 is a family of naval, utility and civil helicopters whose design and development have benefited from the different requirements of each of these operating regimes. The paper examines weapon integration on the EH101, focusing on the overall weapon system of which the helicopter is a major component. While the details provided are in most instances generic to all naval EH101 variants, specific details of the Royal Navy's Merlin HM Mk.1 helicopter are given where appropriate. The paper also outlines the highly complex contractual structures that lie behind the Merlin HM Mk.1 program. The paper concludes with a number of lessons that should be of advantage to future weapon integration programs.
Derived from text
Helicopters; Helicopter Control; Helicopter Performance

19970026159 Eurocopter Deutschland G.m.b.H., Munich, Germany
TIGER
Wennekers, R., Eurocopter Deutschland G.m.b.H., Germany; Jul. 1997; 26p; In English; Also announced as 19970026150; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The development of the TIGER helicopter/weapon system is a joint effort at equal parts of Germany and France to meet the requirements for combat support, air-to-air protection, escort, reconnaissance and anti-tank helicopter missions in post cold-war conflict scenarios. From a basic helicopter and avionics system the following versions are derived.

Derived from text

Helicopters; Reconnaissance; Combat; Avionics

19970026241 CSA Engineering, Inc., Palo Alto, CA USA
Development of Preliminary Design Models for Active Aeroelastic Wing Application ***Final Report, Oct. 1994 - Dec. 1996***
Eastep, Frank, CSA Engineering, Inc., USA; Jan. 1997; 134p; In English
Contract(s)/Grant(s): F33615-94-C-3200; AF Proj. 2401
Report No.(s): AD-A325358; WL-TR-97-3019; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

An investigation of active aeroelastic wing (AAW) technology was initially conducted on a 'beam rod' model of an FIA-18 aircraft for demonstration of an acceptable roll performance. The beam rod model was verified by comparing the natural frequencies to the results obtained by McDonnell-Douglas during a ground vibration test. Further verification of the beam-rod model and selected aerodynamic representation of the FIA-18 were obtained in flutter studies. The beam-rod model was further developed for active aeroelastic wing technology through a study of control surface blending for the roll performance enhancement of the FIA-18 with a reduction of wing stiffening. It is demonstrated that the roll performance of the FIA-18 could be enhanced by incorporating AAW concepts in the design stage of aircraft development It was determined that a finite- element representation of the built-up wing was necessary for the accurate prediction of aeroelastic deformation. A generic built-up fighter wing was considered to demonstrate preliminary design methods incorporating aeroelastic wing technology. Optimization studies of this aircraft wing were conducted utilizing multiple blended control surfaces to effect roll trim.

DTIC

Design Analysis; Product Development; Aeroelasticity; Wings

19970026337 Washington State Univ., School of Medical and Materials Engineering, Pullman, WA USA
LDA Measurements over an Oscillating Rectangular Wing ***Final Report, 1 May 1995 - 31 Dec. 1996***
Ramaprian, B. R., Washington State Univ., USA; Mar. 14, 1997; 38p; In English
Contract(s)/Grant(s): DAAH04-95-I-0170
Report No.(s): AD-A325168; ARO-33857.3-EG; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Experimental results of measurement of the phase-locked velocity distributions in the three-dimensional vortical region over the tip region of a rectangular wing oscillating sinusoidally about its quarter-chord axis are reported. The tests were conducted in a low-speed wind tunnel at a Reynolds number of 350,000 and velocity measurements were made using a three-component Laser Doppler Anemometer (LDA). The wing was oscillated at a frequency of 1 HZ and an amplitude of 4 degrees about a mean angle of incidence of 15 degrees. The data indicate that under the conditions tested, there is no massive flow reversal occurring anywhere over the tip region. The velocity distributions were however highly distorted from the usual boundary layer-like shapes and exhibited significant hysteresis between the pitch-up and pitch-down parts of the oscillating cycle. There was a small but significant amount of cross-flow even at the most inboard station measured. The vicinity of the wing tip was characterized by a strong axial vortex, which originated at a distance of about 30% chord from the leading edge and grew to a size of about 20% chord at the trailing edge. The extensive set of velocity data have been archived on electronic storage and are available to any interested user.

DTIC

Laser Doppler Velocimeters; Anemometers; Velocity Distribution; Velocity Measurement; Rectangular Wings; Three Dimensional Flow; Wind Tunnel Tests

19970026356 Defence Science and Technology Organisation, Airframes and Engines Div., Canberra, Australia
Finite Element Analysis of an F-111 Lower Wing Skin Fatigue Crack Repair
Callinan, R. J., Defence Science and Technology Organisation, Australia; Sanderson, S., Defence Science and Technology Organisation, Australia; Keeley, D., Defence Science and Technology Organisation, Australia; Jan. 1997; 67p; In English
Report No.(s): AD-A324657; DSTO-TN-0067; DODA-AR-009-961; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

In this report a three dimensional Finite Element (FE) model has been developed for a structural detail in an F-111 lower wing skin. The location of interest is a fuel flow groove in the lower wing skin where cracking had occurred in service on aircraft A8-145. Detailed models were developed for: (1) un-cracked structure; (2) he cracked structure and (3) the repaired structure, using bonded composite patch for the repair. The objective of this work is to validate the design analysis used by the RAAF, using an independent approach for the stress analysis. The FE model has been validated using strain gauge results from a full scale test wing. The results of the FE analysis are shown to compare favourably with closed form solutions used by the RAAF (RAAF Engineering Standard C5033) in the original design of the repair. Thus the present work provides a basis for confidence in the design procedures contained in RAAF Engineering Standard C5033.
DTIC
Finite Element Method; Wings; Fatigue Life; Aircraft Maintenance; Aircraft Models

19970026940 Dayton Univ., Research Inst., OH USA
User's Guide for FAR23 Loads Program ***Final Report***
Miedlar, P., Dayton Univ., USA; Mar. 1997; 143p; In English
Contract(s)/Grant(s): FAA-93-G-051
Report No.(s): AD-A324952; UDR-TR-96-83; DOT/FAA/AR-96/46; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The FAR23 Loads program provides a procedure for calculating the loads on an airplane according to the Code of Federal Regulations, Title l4-Aeronautics and Space, Chapter 1 -Federal Aviation Administration, Subchapter C-Aircraft, Part 23 Airworthiness Standards: Normal, Utility, Aerobatics, and Commuter Category Airplanes, Subpart C-Structures. Most of the detail flight loads are developed from the flight envelopes specified in FARs 23.333 and 23.345. At every point specified in the flight envelope, the airplane is balanced by a tail load reacting to the specified liner normal acceleration and the aerodynamic lift, drag, and moment about the center of gravity. The data needed to make these balancing calculations consists of: (1) weight and center of gravity, (2) aerodynamic surface geometry, (3) structural speeds, and (4) aerodynamic coefficients. After the balanced load data are developed, the critical structural loads are determined for each component. For the critical conditions, the air loads, inertial loads, and net loads are calculated. Aileron, flap, tab, engine mount, landing, and one engine out loads are also calculated. Landing loads are calculated from the landing gear geometry, landing load factor, weight, and center of gravity data. The FAR23 Loads program was developed by Aero Science Software to calculate th e loads on an airplane using methods acceptable to the FAA. The program includes 20 modules that are each self contained programs designed for a specific application.
DTIC
Applications Programs (Computers); User Manuals (Computer Programs); Aerodynamic Loads; Aerodynamics; Aircraft Reliability; Commuter Aircraft; Control Surfaces; Aircraft Structures

19970026988 Air Force Flight Test Center, Air Force Materiel Command, Edwards AFB, CA USA
Air Force Flight Test Center Toland Users' Guide: Technical Information Handbook ***Final Report***
Standley, Kent, Air Force Flight Test Center, USA; Sep. 1996; 194p; In English
Report No.(s): AD-A286920; AFFTC-TIH-96-02; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

This report describes a computer program that will model the takeoff and landing performance of aircraft. The program is written in Microsoft(TM) FORTRAN for execution on an IBM-compatible personal computer running with DOS 3.3 or better. Models of lift coefficient, drag coefficient, gross thrust, propulsive drag, and fuel within user-provided subroutines are required. The simulated aircraft can be jet or propeller powered, however, thrust must be passed from the user-provided subroutine. The intent of this handbook is to provide a guide to the programmer and operator of this program as well as to document the equations and assumptions used in the program. This program was adapted from the NASA takeoff and landing program documented in NASA Technical Memorandum X.622,333, (1973). This Air Force version of the program has been made to suit the needs of test and evaluation while the NASA program served as a design tool.
DTIC
Applications Programs (Computers); Flight Tests; Takeoff; Aircraft Landing; Computerized Simulation; User Manuals (Computer Programs); Aircraft Performance

19970027223 Naval Postgraduate School, Monterey, CA USA
Acoustic Source and Data Acquisition System for a Helicopter Rotor Blade-Vortex Interaction (BVI) Noise Reduction Experiment
Roth, Brian D., Naval Postgraduate School, USA; Dec. 1996; 74p; In English
Report No.(s): AD-A326229; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

One of the most objectional noises produced by a helicopter is due to interaction of a rotor blade with a previously shed vortex. Various methods have been proposed to reduce this blade/vortex interaction (BVI) noise; this investigation is concerned with BVI noise reduction by rotor blade tip design modifications. Potentially much can be learned regarding the prospect for success of a candidate rotor blade design at greatly reduced time and money by performing acoustic scattering measurements in an anechoic chamber. It is proposed that a rotor blade which scatters acoustic waves less could be expected to produce less BVI noise. This thesis describes the development of the acoustic source and computer controlled data acquisition system for such a scattering experiment.

DTIC

Acoustic Scattering; Sound Generators; Rotor Aerodynamics; Interactional Aerodynamics; Blade-Vortex Interaction; Aerodynamic Noise; Sound Waves

19970027229 Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA

Augmentation of Research at the Center of Excellence in Rotorcraft Technology (CERT) ***Final Report***

Schrage, Daniel P., Georgia Inst. of Tech., USA; Sankar, L. N., Georgia Inst. of Tech., USA; Komerath, N., Georgia Inst. of Tech., USA; Peters, D. A., Georgia Inst. of Tech., USA; Hodges, D. H., Georgia Inst. of Tech., USA; Kardomates, G. A., Georgia Inst. of Tech., USA; Armanios, E. A., Georgia Inst. of Tech., USA; Calise, A. J., Georgia Inst. of Tech., USA; Hanagud, S. V., Georgia Inst. of Tech., USA; Loewy, R. G., Georgia Inst. of Tech., USA; Prasad, J. V. R., Georgia Inst. of Tech., USA; Mar. 31, 1997; 238p; In English

Contract(s)/Grant(s): DAAH04-94-G-0072; DA Proj. E-16-X35

Report No.(s): AD-A326337; GIT-AER-E16-X35; ARO-32323.8-EG-RW; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Rotorcraft technology is one of the most challenging, multidisciplinary and interdisciplinary problems in engineering. For its sustained advancement requires a critical mass of researchers conducting interdisciplinary research in the four critical rotorcraft disciplines: aerodynamics, rotor dynamics and aeroelasticity, structures and materials, and flight mechanics and controls. To support and sustain this research requires a combination of analysis capabilities and experimental facilities, including the necessary research instrumentation. The Georgia Tech CERT has accumulated this critical mass of researchers and developed the necessary facilities with previous Army and Georgia Tech investments. The unique capabilities of rotorcraft (vertical flight and lifting capability, ability to operate from unprepared surfaces, low speed agility and maneuverability, etc.) make them essential weapon and support systems for the U.S. Army and other military services in the foreseeable future. Therefore, the problem studied is to sustain the advancement of rotorcraft technology by conducting leading edge research using sufficient research instrumentation for the direct benefit of future rotorcraft, as well as technology upgrades for existing rotorcraft.

DTIC

Augmentation; Rotary Wing Aircraft; Rotor Dynamics; Research Management; Aeronautical Engineering

19970027238 Transportoekonomisk Inst., Oslo, Norway

Cost-Benefit Analysis of Rescue Helicopters in Norway ***Nytte-Kostnadsanalyse av Redningshelikoptrene***

Elvik, R., Transportoekonomisk Inst., Norway; Oct. 1996; 99p; In Norwegian

Report No.(s): PB97-144265; TOI-1033/1996; Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The report contains a cost-benefit analysis of rescue helicopters in Norway. Current services as well as two alternative patterns of deployment are assessed. The benefits of current services exceed costs by a factor of 5.4. Shortening the required response time from 60 minutes to 15 minutes also provides a benefit exceeding costs.

NTIS

Rescue Operations; Costs; Cost Analysis; Medical Services; Helicopters

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19970027071 NASA Dryden Flight Research Center, Edwards, CA USA

Flight Demonstration of a Shock Location Sensor Using Constant Voltage Hot-Film Anemometry

Moes, Timothy R., NASA Dryden Flight Research Center, USA; Sarma, Garimella R., Tao of Systems Integration, Inc., USA; Mangalam, Siva M., Tao of Systems Integration, Inc., USA; Aug. 1997; 28p; In English; Society of Flight Test Engineers,

18-22 Aug. 1997, Orlando, FL, USA; Sponsored by Society of Flight Test Engineers, USA
Contract(s)/Grant(s): RTOP 529-21-34-00-38
Report No.(s): NASA-TM-4806; NAS 1.15:4806; H-2191; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flight tests have demonstrated the effectiveness of an array of hot-film sensors using constant voltage anemometry to determine shock position on a wing or aircraft surface at transonic speeds. Flights were conducted at the NASA Dryden Flight Research Center using the F-15B aircraft and Flight Test Fixture (FTF). A modified NACA 0021 airfoil was attached to the side of the FTF, and its upper surface was instrumented to correlate shock position with pressure and hot-film sensors. In the vicinity of the shock-induced pressure rise, test results consistently showed the presence of a minimum voltage in the hot-film anemometer outputs. Comparing these results with previous investigations indicate that hot-film anemometry can identify the location of the shock-induced boundary layer separation. The flow separation occurred slightly forward of the shock- induced pressure rise for a laminar boundary layer and slightly aft of the start of the pressure rise when the boundary layer was tripped near the airfoil leading edge. Both minimum mean output and phase reversal analyses were used to identify the shock location.
Author

F-15 Aircraft; Transonic Speed; Pressure Sensors; Leading Edges; Laminar Boundary Layer; Hot-Film Anemometers; Airfoils

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.

19970026099 Wichita State Univ., Mechanical Engineering Dept., Wichita, KS USA
Design Procedures and Analysis of Turbine Rotor Fragment Hazard Containment ***Final Report***
Mathis, J. A., Wichita State Univ., USA; Mar. 1997; 34p; In English
Report No.(s): AD-A325132; DOT/FAA/AR-96/121; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Containment design procedures are reviewed through an extensive literature summary that spans 23 years of research from 1970 to 1993. Sixty-four reports are summarized and cross referenced to provide a useful bibliography on the subject. Comments from industry and government agencies are included along with a study of existing analytical methods. These analytical methods have substantiated that system level engine and nacelle evaluations are research areas that require future development and standardization.
DTIC

Hazards; Aircraft Engines; Gas Turbines; Fragments; Bibliographies

19970026134 NASA Lewis Research Center, Cleveland, OH USA
Computational Infrastructure for Engine Structural Performance Simulation
Chamis, Christos C., NASA Lewis Research Center, USA; Physics and Process Modeling (PPM) and Other Propulsion R and T; Apr. 1997; Volume 2; 10p; In English; Also announced as 19970026130
Report No.(s): Paper-24; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Select computer codes developed over the years to simulate specific aspects of engine structures are described. These codes include blade impact integrated multidisciplinary analysis and optimization, progressive structural fracture, quantification of uncertainties for structural reliability and risk, benefits estimation of new technology insertion and hierarchical simulation of engine structures made from metal matrix and ceramic matrix composites. Collectively these codes constitute a unique infrastructure readiness to credibly evaluate new and future engine structural concepts throughout the development cycle from initial concept, to design and fabrication, to service performance and maintenance and repairs, and to retirement for cause and even to possible recycling. Stated differently, they provide ’virtual’ concurrent engineering for engine structures total-life-cycle-cost.
Author

Computer Programs; Ceramic Matrix Composites; Concurrent Engineering; Structural Reliability; Structural Design

19970026136 NASA Lewis Research Center, Cleveland, OH USA
Optimization of Air-Breathing Propulsion Engine Concepts
Patnaik, Surya N., Ohio Aerospace Inst., USA; Hopkins, Dale A., NASA Lewis Research Center, USA; Physics and Process Modeling (PPM) and Other Propulsion R and T; Apr. 1997; Volume 2; 12p; In English; Also announced as 19970026130
Contract(s)/Grant(s): NCC3-453
Report No.(s): Paper-26; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Air-breathing propulsion engines play an important role in the development of both civil and military aircraft Design optimization of such engines can lead to higher power, or more thrust for less fuel consumption. A multimission propulsion engine design can be modeled mathematically as a multivariable global optimization problem, with a sequence of subproblems, which are specific to the mission events defined through Mach number, altitude, and power setting combinations.
Derived from text
Optimization; Air Breathing Engines; Aircraft Design; Propulsion

19970026137 NASA Lewis Research Center, Cleveland, OH USA
Technology Needs for Reduced Design and Manufacturing Cost of Commercial Transport Engines
Rohn, Douglas A., NASA Lewis Research Center, USA; Physics and Process Modeling (PPM) and Other Propulsion R and T; Apr. 1997; Volume 2; 10p; In English; Also announced as 19970026130
Report No.(s): Paper-27; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche
The objective of the study was to assess the needs in the design and manufacturing processes and identify areas where technology could impact in cost and cycle-time reduction. At the highest level, the team first identified the goals that were in line with long-range needs of the aeropropulsion industry, and to which technology and process improvements would be required to contribute. These goals are to reduce the time and costs in the development cycle of aircraft engines by a factor of two, reduce production cycle time by a factor of four, and to reduce production costs by 25%. Also, it was the intent of the team to identify the highest impact technologies that could be developed and demonstrated in five years.
Author
Cost Reduction; Production Costs; Aircraft Engines; Commercial Aircraft

19970026220 European Research Office (US Army), London, UK
Oscillations in Gas-Turbine Combustors; Control of Rumble, Pattern Factor and Emissions ***Final Report***
Whitelaw, J. H., European Research Office (US Army), UK; Dec. 1996; 11p; In English
Contract(s)/Grant(s): N68171-95-C-9140
Report No.(s): AD-A324956; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The proposal which led to the above contract required that measurements be obtained in the combustor of a small gas turbine so as to determine the extent to which oscillations of the gaseous fuel supply would lead to reductions in NO(x) emissions and improvements in pattern factor. The 60 degree sector of the annular combustor in which the measurements were obtained is shown on figure 1 and has been used for many previous steady-state experiments, see for example Bicen, Senda and Whitelaw (1988). It operated with a single primary-zone vortex driven by three film-cooling wall jets and curtailed by the five primary jets. Dilution was achieved with four jets from the outer diameter and two from the inner diameter and directly opposite to two of the outer jets. Results were obtained with and without a turn-around duct, as used in the helicopter for which the engine was designed. The air was supplied through a plenum chamber surrounding the main combustor and a second plenum surrounding the turn-around duct with its own film cooling.
DTIC
Oscillations; Gas Turbines; Emission; Nitrogen Oxides; Combustion Chambers

19970026568 Toronto Univ., Inst. of Aerospace Studies, Ontario Canada
Inviscid Off-Design Propulsive Performance of Hypersonic Shock-Induced Combustion Ramjets
Sislian, J. P., Toronto Univ., Canada; Dudebout, R., Toronto Univ., Canada; Schumacher, J., Toronto Univ., Canada; Islam, M., Toronto Univ., Canada; Redford, T., Toronto Univ., Canada; Jun. 1997; ISSN 0082-5255; 262p; In English
Contract(s)/Grant(s): NSERC-OGP-0006328
Report No.(s): UTIAS-Rept-354; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche
A physical shock-induced combustion ramjet (shcramjet) model is described to investigate the effects of incomplete fuel/air mixing and off-design flight conditions on its performance characteristics. Axisymmetric and planar shcramjet flowfields with variable equivalence ratio profiles representing extreme deviations from homogeneous fuel/air mixing, are numerically solved for a range of flight Mach numbers at a constant dynamic pressure of 1400 psf. A fully implicit, fully coupled, Newton-iteration, Lower-Upper Symmetric Gauss-Seidel (LU-SGS) scheme is employed to solve the Euler equations at steady-state. This scheme is coupled with a nonequilibrium chemistry model consisting of 33 reactions and 13 species. Results show that incomplete fuel/air mixing gives rise to a combination of detonative combustion and simple shock-induced combustion. Comparison of overall performance characteristics to shcramjets with homogeneous, stoichiometric fuel/air mixtures demonstrates the degree of performance degradation. The propulsive characteristics of mixed-compression ramjets are calculated in off-design operating regimes corresponding to inlet Mach numbers above and below design Mach numbers of 12, 16 and 20; for external-compression ramjets,

the propulsive characteristics are calculated for inlet Mach numbers below design Mach numbers of 12, 16 and 20. It is found that the propulsive properties of the engines deteriorate when they are operated at off-design conditions. For mixed-compression ramjets operating at lower-than-design Mach numbers, the degradation in thrust production is due primarily to reduced heat release in the engine nozzle. At higher-than-design Mach numbers, thrust production is reduced only slightly due to a modified nozzle geometry, required to ensure convergence of the numerical method. Generation of thrust for external-compression ramjets deteriorates at lower-than-design Mach numbers due to a high-pressure zone created in the combustor by the impingement of the detonation wave on the engine surface upstream of the design point. Mixed-compression ramjets are found to provide superior performance to external-compression ramjets at off-design operation. External-compression ramjets are found to be more sensitive to off-design operation than mixed-compression ramjets. It is concluded that the engine geometry must be varied as flight conditions change if degradation in engine performance at off-design conditions is to be avoided.
Author
Ramjet Engines; Hypersonic Combustion; Mach Number; Propulsion System Performance; Iterative Solution; Newton Methods; Detonation Waves

19970026602 NASA Lewis Research Center, Cleveland, OH USA
Imaging Fluorescent Combustion Species in Gas Turbine Flame Tubes: On Complexities in Real Systems
Hicks, Y. R., NASA Lewis Research Center, USA; Locke, R. J., NYMA, Inc., USA; Anderson, R. C., NASA Lewis Research Center, USA; Zaller, M., NASA Lewis Research Center, USA; Schock, H. J., Michigan State Univ., USA; Jun. 1997; 18p; In English; 33rd; Joint Propulsion, 6-9 Jul. 1997, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Contract(s)/Grant(s): NAS3-27186; RTOP 537-05-20
Report No.(s): NASA-TM-107491; NAS 1.15:107491; E-10788; AIAA Paper 97-2837; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Planar laser-induced fluorescence (PLIF) is used to visualize the flame structure via OH, NO, and fuel imaging in kerosene-burning gas turbine combustor flame tubes. When compared to simple gaseous hydrocarbon flames and hydrogen flames, flame tube testing complexities include spectral interferences from large fuel fragments, unknown turbulence interactions, high pressure operation, and the concomitant need for windows and remote operation. Complications of these and other factors as they apply to image analysis are considered. Because both OH and gas turbine engine fuels (commercial and military) can be excited and detected using OH transition lines, a narrowband and a broadband detection scheme are compared and the benefits and drawbacks of each method are examined.
Author
Laser Induced Fluorescence; Gas Turbine Engines; Combustion; Flames; Hydroxyl Emission; Image Analysis; Hydrogen; Hydrocarbons

19970026603 NASA Lewis Research Center, Cleveland, OH USA
Passage-Averaged Description of Wave Rotor Flow
Welch, Gerard E., NASA Lewis Research Center, USA; Larosiliere, Louis M., NASA Lewis Research Center, USA; Jul. 1997; 12p; In English; 33rd; Joint Propulsion, 6-9 Jul. 1997, Seattle, WA, USA
Contract(s)/Grant(s): RTOP 505-26-33
Report No.(s): NASA-TM-107518; NAS 1.15:107518; E-10822; AIAA Paper 97-3144; ARL-TR-1462; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The unsteady flow within wave rotor passages is influenced by the rotor blade, hub, and tip-shroud surface profiles. by averaging from hub to shroud and from blade to blade, a reduced set of the governing equations is obtained that is appropriate for design studies and parametric analyses. The application of these equations requires closure models for force integrals and for correlation terms that arise when the density-averages of products of the flow field variables are expanded in terms of products of the density-averaged variables. The force integrals and the correlation terms depend on the instantaneous pitchwise and spanwise flow field distributions established by unsteadiness relative to the rotor, flow turning induced by blade, hub, and tip-shroud profiling, and rotation. Two approaches to model the force integrals are described. The influence of relative unsteadiness and flow turning on the correlation terms is discussed by considering the propagation of gas dynamic waves in rotor passages defined by uncambered, staggered blades and by unstaggered, cambered blades.
Author
Rotors; Wave Propagation; Unsteady Flow; Blade Tips; Flow Distribution

19970026604 NASA Lewis Research Center, Cleveland, OH USA

Dynamic Simulation of a Wave Rotor Topped Turboshaft Engine

Greendyke, R. B., Texas A&M Univ., USA; Paxson, D. E., NASA Lewis Research Center, USA; Schobeiri, M. T., Texas A&M Univ., USA; Jul. 1997; 12p; In English; 33rd; Joint Propulsion, 6-9 Jul. 1997, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 523-26-33

Report No.(s): NASA-TM-107514; NAS 1.15:107514; E-10816; AIAA Paper 97-3143; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The dynamic behavior of a wave rotor topped turboshaft engine is examined using a numerical simulation. The simulation utilizes an explicit, one-dimensional, multi-passage, CFD based wave rotor code in combination with an implicit, one-dimensional, component level dynamic engine simulation code. Transient responses to rapid fuel flow rate changes and compressor inlet pressure changes are simulated and compared with those of a similarly sized, untopped, turboshaft engine. Results indicate that the wave rotor topped engine responds in a stable, and rapid manner. Furthermore, during certain transient operations, the wave rotor actually tends to enhance engine stability. In particular, there is no tendency toward surge in the compressor of the wave rotor topped engine during rapid acceleration. In fact, the compressor actually moves slightly away from the surge line during this transient. This behavior is precisely the opposite to that of an untopped engine. The simulation is described. Issues associated with integrating CFD and component level codes are discussed. Results from several transient simulations are presented and discussed.

Author

Turboshafts; Inlet Pressure; Dynamic Characteristics; Flow Velocity; Fuel Flow; Transient Response; Computerized Simulation

19970026860 NASA Lewis Research Center, Cleveland, OH USA

Effect of Coolant Temperature and Mass Flow on Film Cooling of Turbine Blades

Garg, Vijay K., AYT Corp., USA; Gaugler, Raymond E., NASA Lewis Research Center, USA; Int. J. Heat Mass Transfer; Jan. 01, 1997; ISSN 0017-9310; Volume 40, No. 2, pp. 435-445; In English

Report No.(s): NASA-TM-112760; NAS 1.15:112760; ASME Paper-95WA/HT-1; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

A three-dimensional Navier Stokes code has been used to study the effect of coolant temperature, and coolant to mainstream mass flow ratio on the adiabatic effectiveness of a film-cooled turbine blade. The blade chosen is the VKI rotor with six rows of cooling holes including three rows on the shower head. The mainstream is akin to that under real engine conditions with stagnation temperature = 1900 K and stagnation pressure = 3 MPa. Generally, the adiabatic effectiveness is lower for a higher coolant temperature due to nonlinear effects via the compressibility of air. However, over the suction side of shower-head holes, the effectiveness is higher for a higher coolant temperature than that for a lower coolant temperature when the coolant to mainstream mass flow ratio is 5% or more. For a fixed coolant temperature, the effectiveness passes through a minima on the suction side of shower-head holes as the coolant to mainstream mass flow, ratio increases, while on the pressure side of shower-head holes, the effectiveness decreases with increase in coolant mass flow due to coolant jet lift-off. In all cases, the adiabatic effectiveness is highly three-dimensional.

Author

Turbine Blades; Stagnation Temperature; Stagnation Pressure; Rotors; Hole Distribution (Mechanics); Film Cooling; Compressibility

08
AIRCRAFT STABILITY AND CONTROL

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

19970026081 Air Force Flight Test Center, Edwards AFB, CA USA

Limited Handling Qualities Evaluation of Augmented Longitudinal Flight Control Systems Designed with State-Space Optimization Techniques (HAVE INFINITY) ***Final Report, Jul. - Dec. 1996***

Edwards, Phillip T., Air Force Flight Test Center, USA; Fittante, Philip R., Air Force Flight Test Center, USA; DeLiberato, Tony, Air Force Flight Test Center, USA; Snyder, Steven P., Air Force Flight Test Center, USA; Yarger, Thomas W., Air Force Flight Test Center, USA; Jan. 1997; 81p; In English

Report No.(s): AD-A325252; AFFTC-TR-96-39; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This technical report presents the results of a limited handling qualities evaluation of augmented longitudinal flight control systems designed with state-space optimization techniques. The objective of the test was to evaluate the handling qualities of four

longitudinal flight control systems during the approach and landing phase of flight. Three of the flight control systems used state-space design techniques and the fourth used classical design techniques. The four flight control systems were evaluated using the Variable Stability Simulator 2 (VSS 2), which was a highly modified Learjet Model 25. Testing was requested by Wright Laboratory, Wright-Patterson AFB, Ohio, and was conducted under the authority of the Commandant, USAF Test Pilot School.
DTIC
Longitudinal Control; Flight Control; Controllability

19970026105 NASA Dryden Flight Research Center, Edwards, CA USA
Supersonic Flying Qualities Experience Using the SR-71
Cox, Timothy H., NASA Dryden Flight Research Center, USA; Jackson, Dante, Analytical Services and Materials, Inc., USA; Aug. 1997; 16p; In English; Atmospheric Flight Mechanics, 11-13 Aug. 1997, New Orleans, LA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 529-50-24
Report No.(s): NASA-TM-4800; NAS 1.15:4800; H-2178; AIAA Paper 97-3654; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Approximately 25 years ago NASA Dryden Flight Research Center, Edwards, California, initiated the evaluation of supersonic handling qualities issues using the XB-70 and the YF-12. Comparison of pilot comments and ratings with some of the classical handling qualities criteria for transport aircraft provided information on the usefulness of these criteria and insight into supersonic flying qualities issues. A second research study has recently been completed which again addressed supersonic flying qualities issues through evaluations of the SR-71 in flight at Mach 3. Additional insight into supersonic flying qualities issues was obtained through pilot ratings and comments. These ratings were compared with existing military specifications and proposed criteria for the High Speed Civil Transport. This paper investigates the disparity between pilot comments and the Neal/Smith criteria through a modification of the technique using vertical speed at the pilot station. The paper specifically addresses the pilot ability to control flightpath and pitch attitude in supersonic flight and pilot displays typical of supersonic maneuvering.
Author
SR-71 Aircraft; Transport Aircraft; Supersonic Flight; Flight Paths; Flight Characteristics; Controllability; B-70 Aircraft

19970026120 NASA Lewis Research Center, Cleveland, OH USA
Speed Sensorless Induction Motor Drives for Electrical Actuators: Schemes, Trends and Tradeoffs
Elbuluk, Malik E., Akron Univ., USA; Kankam, M. David, NASA Lewis Research Center, USA; May 1997; 11p; In English; National Aerospace and Electronics, 14-18 Jul. 1997, Dayton, OH, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA; Meeting Sponsored in part by IEEE Aerospace and Electronics Systems Society.
Contract(s)/Grant(s): RTOP 233-1A-1C
Report No.(s): NASA-TM-107466; E-10752; NAS 1.15:107466; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

For a decade, induction motor drive-based electrical actuators have been under investigation as potential replacement for the conventional hydraulic and pneumatic actuators in aircraft. Advantages of electric actuator include lower weight and size, reduced maintenance and operating costs, improved safety due to the elimination of hazardous fluids and high pressure hydraulic and pneumatic actuators, and increased efficiency. Recently, the emphasis of research on induction motor drives has been on sensorless vector control which eliminates flux and speed sensors mounted on the motor. Also, the development of effective speed and flux estimators has allowed good rotor flux-oriented (RFO) performance at all speeds except those close to zero. Sensorless control has improved the motor performance, compared to the Volts/Hertz (or constant flux) controls. This report evaluates documented schemes for speed sensorless drives, and discusses the trends and tradeoffs involved in selecting a particular scheme. These schemes combine the attributes of the direct and indirect field-oriented control (FOC) or use model adaptive reference systems (MRAS) with a speed-dependent current model for flux estimation which tracks the voltage model-based flux estimator. Many factors are important in comparing the effectiveness of a speed sensorless scheme. Among them are the wide speed range capability, motor parameter insensitivity and noise reduction. Although a number of schemes have been proposed for solving the speed estimation, zero-speed FOC with robustness against parameter variations still remains an area of research for speed sensorless control.
Author
Actuators; Induction Motors; Electromechanical Devices; Speed Control

19970026414 Institute for Human Factors TNO, Soesterberg, Netherlands
Development and Performance of a Cockpit Control System Operated by Voice
Steeneken, H. J. M., Institute for Human Factors TNO, Netherlands; Pijpers, E. W., National Aerospace Lab., Netherlands; Jun.

1997; 4p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

The hands and eyes busy situation and high workload as is normally the case in a fighter cockpit require a natural means of communication between operator and system. Voice is an obvious means of communication, however the adverse cockpit conditions deteriorate the speech signal in such a way that automatic recognition of spoken commands is difficult. In this study the performance of a voice controlled cockpit was investigated. An automatic speech recognizer was integrated in the control system of a F-16 simulator. The performance was evaluated during representative operational simulated flights. A similar study was performed by Prevot and Onken (1995). The results indicate that a flexible syntax of the commands is required. The recognition performance (75%) of the connected command strings was not good enough to accommodate the pilots. From flight tests a representative spontaneous speech data base was collected for further improvements.

Author

Aircraft Instruments; Man Machine Systems; Voice Communication; Aircraft Pilots; Speech Recognition; Flight Tests; Voice Control

19970026582 Tuskegee Research Inst., AL USA

A Low Cost Simulation System to Demonstrate Pilot Induced Oscillation Phenomenon ***Final Report, 1 Apr. 1994 - 15 Jan. 1997***

Ali, Syed Firasat, Tuskegee Research Inst., USA; 1997; 51p; In English

Contract(s)/Grant(s): NAG2-4006

Report No.(s): NASA-CR-204540; NAS 1.26:204540; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A flight simulation system with graphics and software on Silicon Graphics computer workstations has been installed in the Flight Vehicle Design Laboratory at Tuskegee University. The system has F-15E flight simulation software from NASA Dryden which uses the graphics of SGI flight simulation demos. On the system, thus installed, a study of pilot induced oscillations is planned for future work. Preliminary research is conducted by obtaining two sets of straight level flights with pilot in the loop. In one set of flights no additional delay is used between the stick input and the appearance of airplane response on the computer monitor. In another set of flights, a 500 ms additional delay is used. The flight data is analyzed to find cross correlations between deflections of control surfaces and response of the airplane. The pilot dynamics features depicted from cross correlations of straight level flights are discussed in this report. The correlations presented here will serve as reference material for the corresponding correlations in a future study of pitch attitude tracking tasks involving pilot induced oscillations.

Author

Pilot Induced Oscillation; Computer Programs; Computerized Simulation; Flight Simulation; Low Cost

19970027245 Duke Univ., Office of Research Support, Durham, NC USA

Nonlinear Dynamics and Control of Wings and Panels ***Final Report, 1 Jul. 1994 - 30 Jun. 1996***

Dowell, Earl H., Duke Univ., USA; Virgin, Lawrence, Duke Univ., USA; Clark, Robert, Duke Univ., USA; Dec. 04, 1996; 18p; In English

Contract(s)/Grant(s): F49620-94-I-0382

Report No.(s): AD-A325730; AFOSR-97-0159TR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A multidisciplinary team of experts in aeroelasticity, control and nonlinear dynamics will study experimentally and theoretically the control of prototypical aeroelastic systems. Emphasis will be given to those systems with significant nonlinear characteristics, e.g. freeplay structural behavior and aeroelastic stall behavior for airfoils and wings and geometrical structural behavior and aeroelastic stall behavior for airfoils and wings and geometric structural nonlinearities of panels (plates and shells). Research in nonlinear dynamics has reached a level of relative maturity such that applications to real engineering systems (including physical experiments) are the next major advance. Adaptive control strategies will be employed to attenuate both persistent and impulsive disturbances for nonlinear mechanical and aeroelastic systems will be used to aid in the design of distributed control structures with a focus on model-intensive control algorithms.

DTIC

Nonlinear Systems; Dynamic Control; Distributed Parameter Systems; Aeroelasticity; Adaptive Control; Airfoils; Active Control

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.

19970026140 NASA Lewis Research Center, Cleveland, OH USA

A New 1000 F Magnetic Bearing Test Rig

Kascak, Albert F., Army Research Lab., USA; Montague, Gerald T., Army Research Lab., USA; Brown, Gerald V., NASA Lewis Research Center, USA; Palazzolo, Alan B., Texas A&M Univ., USA; Physics and Process Modeling (PPM) and Other Propulsion R and T; Apr. 1997; Volume 2; 14p; In English; Also announced as 19970026130

Report No.(s): Paper-30; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

NASA and the Army are currently exploring the possibility of using magnetic bearings in gas turbine engines. The use of magnetic bearings in gas turbine engines could increase the reliability by eliminating the lubrication system. The use of magnetic bearings could also increase the speed and the size of the shafts in the engine, thus reducing vibrations and possibly eliminating third bearings. Magnetic bearings can apply forces to the shafts and move them so that blade tips and seals do not rub. This could be part of an active vibration cancellation system. Also, whirling (displacing the shaft center line) may delay rotating stall and increase the stall margin of the engine. Magnetic bearings coupled with an integral starter generator could result in a more efficient 'more electric' engine. The IHPTET program, a joint DOD-industry program, has identified a need for a high temperature, (as high as 1200 F), magnetic bearing that could be demonstrated in a phase m engine. A magnetic bearing is similar to an electric motor. The magnetic bearing has a laminated rotor and stator made out of cobalt steel. The stator has a series of coils of wire wound around it. These coils f u. a series of electromagnets around the circumference. These magnets exert a force on the rotor to keep the rotor in the center of the cavity. The centering force is commanded by a controller based on shaft position, (measured by displacement probes). The magnetic bearing can only pull and is basically unstable before active control is applied The engine shafts, bearings, and case form a flexible structure which contain a large number of modes. A controller is necessary to stabilize these modes. A power amplifier is also necessary to provide the current prescribed by the controller to the magnetic bearings. In case of very high loads, a conventional back up bearing will engage and stop the rotor and stator from rubbing.

Derived from text

Magnetic Bearings; Shafts (Machine Elements); Rotating Stalls; Lubrication Systems; Loads (Forces); High Temperature; Gas Turbine Engines; Active Control; Test Stands; Test Equipment

19970026897 Carroll Coll., Dept. of Mathematics and Engineering, Helena, MT USA

Computer Based Training: Field Deployable Trainer and Shared Virtual Reality ***Final Report***

Mullen, Terence J., Carroll Coll., USA; National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program: 1996; Jun. 1997; Volume 2; 6p; In English; Also announced as 19970026889; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Astronaut training has traditionally been conducted at specific sites with specialized facilities. Because of its size and nature the training equipment is generally not portable. Efforts are now under way to develop training tools that can be taken to remote locations, including into orbit. Two of these efforts are the Field Deployable Trainer and Shared Virtual Reality projects. Field Deployable Trainer NASA has used the recent shuttle mission by astronaut Shannon Lucid to the Russian space station, Mir, as an opportunity to develop and test a prototype of an on-orbit computer training system. A laptop computer with a customized user interface, a set of specially prepared CD's, and video tapes were taken to the Mir by Ms. Lucid. Based upon the feedback following the launch of the Lucid flight, our team prepared materials for the next Mir visitor. Astronaut John Blaha will fly on NASA/MIR Long Duration Mission 3, set to launch in mid September. He will take with him a customized hard disk drive and a package of compact disks containing training videos, references and maps. The FDT team continues to explore and develop new and innovative ways to conduct offsite astronaut training using personal computers. Shared Virtual Reality Training NASA's Space Flight Training Division has been investigating the use of virtual reality environments for astronaut training. Recent efforts have focused on activities requiring interaction by two or more people, called shared VR. Dr. Bowen Loftin, from the University of Houston, directs a virtual reality laboratory that conducts much of the NASA sponsored research. I worked on a project involving the development of a virtual environment that can be used to train astronauts and others to operate a science unit called a Biological Technology Facility (BTF). Facilities like this will be used to house and control microgravity experiments on the space station. It is hoped

that astronauts and instructors will ultimately be able to share common virtual environments and, using telephone links, conduct interactive training from separate locations.
Author
Virtual Reality; Training Devices; Space Transportation System Flights; Space Stations; Space Flight Training; Personal Computers; Microgravity; Gravitational Effects; Education; Astronaut Training

19970027050 Civil Aeromedical Inst., Oklahoma City, OK USA
A Flexible Cabin Simulator ***Final Report***
Marcus, Jeffrey H., Civil Aeromedical Inst., USA; Aug. 1997; 22p; In English
Report No.(s): DOT/FAA/AM-97/18; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Experimental research on issues related to emergency evacuation of a passenger aircraft cabin have tended to use existing aircraft cabins. While a great deal of useful information has been collected, these facilities have limited capabilities to be configured to investigate new or unusual cabin arrangements. A concept design for a flexible cabin simulator has been completed and is described. The proposed facility can simulate any aircraft cabin from a small, commuter category aircraft through a multi-aisle, multi-deck mega-jumbo transport. The simulator allows full flexibility in terms of exit type and placement, location and design of interior monuments, and the size and layout of the passenger cabin. Experimental control is possible of interior and exterior illumination levels, the presence of vision obscuring smoke, and the door sill height when using evacuation slides. Built from modular sections, it might be used in the future to investigate new and unusual cabin designs, such as the flying wing. The proposed simulator is described to illustrate its versatility. The associated building and project costs are also discussed.
Author
Commuter Aircraft; Passenger Aircraft; Aircraft Compartments; Aircraft Safety; Emergencies; Training Simulators; Training Devices

10
ASTRONAUTICS

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

19970026369 Fluid Gravity Engineering Ltd., Liphook, UK
Entry and Vehicle Design Considerations
Smith, Arthur, Fluid Gravity Engineering Ltd., UK; May 1995; 24p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In session 4 we shall look at basic equations of motion of a capsule during its approach and entry and note some relationships between trajectory, vehicle parameters and structural and thermal loads in order to investigate which vehicle characteristics are important in capsule aerothermodynamic design. Typical entry scenarios are explained including orbital transfer, aerobraking, and aerocapture. Design considerations for a ballistic capsules are explored with reference to Mars, Titan and Earth return, while a lifting capsule trade-off is considered for Earth return.
Author
Spacecraft Design; Atmospheric Entry; Reentry Vehicles; Aerothermodynamics; Aerodynamic Heating; Equations of Motion; Aerobraking; Aerocapture; Transfer Orbits

19970027211 NASA Johnson Space Center, Houston, TX USA
Pressure Wave Propagation in a Screech Cycle
Sep. 25, 1997; In English; Videotape: 6 min. 35 sec. playing time, in color, with sound
Report No.(s): NASA-TM-112922; CR-198467; NONP-NASA-VT-1997047951; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

The screech noise generation process from supersonic under expanded jets, issuing from a sonic nozzle pressure ratio of 2.4 and 3.3 (expanded Mach number, M(sub j) = 1.10 and 1.42), is investigated experimentally. Spark Schlieren visualization at differ-

ent phases of the screech cycle are clearly shown. The rms pressure fluctuation at the screech frequency is measured in the near field region by a traversing microphone.
CASI
Supersonic Jet Flow; Sonic Nozzles; Nozzle Flow; Noise Generators; Wave Propagation; Elastic Waves; Gas Jets; Sound Waves; Sound Pressure; Oscillating Flow; Jet Aircraft Noise; Noise Reduction

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.

19970026212 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
The Biodegradation Characteristics of Proposed Fuel Systems Icing Inhibitors (FSII)
Meshako, Charles E., Air Force Inst. of Tech., USA; Dec. 1996; 73p; In English
Report No.(s): AD-A325103; AFIT/GEE/ENV/96D-12; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The biodegradation characteristics of three fuel system icing inhibitors (FSII) were evaluated. FSII are jet fuel additives that partition into water readily and are present in the water drained from storage tank bottoms in concentrations approaching 40%. These concentrations raise concerns as to the disposal and handling of these wastes. The current FSII, DiEGME was evaluated along with two new candidates, dipropylene glycol and glycerol formal. DiEGME appeared to be moderately but not completely biodegradable. It is likely that much of it would be removed in a wastewater treatment plant. Dipropylene glycol only showed signs of degradation after more than three weeks at which point it degraded moderately well. The third FSII, glycerol formal did not show any signs of biodegradability during the five week period of testing. Preliminary toxicity and inhibitory tests were carried out for these chemicals at high and low concentrations. DiEGME appeared to be most toxic to microorganisms at high concentrations, dipropylene glycol show moderate toxicity, and glycerol formal showed little. At low concentrations, none of the chemicals appeared to inhibit the activity of microorganisms.
DTIC
Fuel Systems; Ice Formation; Jet Engine Fuels; Addition

19970027074 NASA Ames Research Center, Moffett Field, CA USA
Evaluation of Thermal Control Coatings for Flexible Ceramic Thermal Protection Systems
Kourtides, Demetrius, NASA Ames Research Center, USA; Carroll, Carol, NASA Ames Research Center, USA; Smith, Dane, NASA Ames Research Center, USA; Guzinski, Mike, Thermoscience Inst., USA; Marschall, Jochen, Thermoscience Inst., USA; Pallix, Joan, Thermoscience Inst., USA; Ridge, Jerry, Thermoscience Inst., USA; Tran, Duoc, Thermoscience Inst., USA; Jul. 1997; 18p; In English
Contract(s)/Grant(s): RTOP 242-20-01
Report No.(s): NASA-TM-112199; NAS 1.15:112199; A-976757; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report summarizes the evaluation and testing of high emissivity protective coatings applied to flexible insulations for the Reusable Launch Vehicle technology program. Ceramic coatings were evaluated for their thermal properties, durability, and potential for reuse. One of the major goals was to determine the mechanism by which these coated blanket surfaces become brittle and try to modify the coatings to reduce or eliminate embrittlement. Coatings were prepared from colloidal silica with a small percentage of either SiC or SiB6 as the emissivity agent. These coatings are referred to as gray C-9 and protective ceramic coating (PCC), respectively. The colloidal solutions were either brushed or sprayed onto advanced flexible reusable surface insulation blankets. The blankets were instrumented with thermocouples and exposed to reentry heating conditions in the Ames Aeroheating Arc Jet Facility. Post-test samples were then characterized through impact testing, emissivity measurements, chemical analysis, and observation of changes in surface morphology. The results show that both coatings performed well in arc jet tests with backface temperatures slightly lower for the PCC coating than with gray C-9. Impact testing showed that the least extensive surface destruction was experienced on blankets with lower areal density coatings.
Author
Thermal Control Coatings; Thermal Protection; Reusable Launch Vehicles; Reentry Effects; Protective Coatings; Durability; Chemical Analysis; Ceramic Coatings; Brittleness; Aerodynamic Heating

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.

19970026088 SRI International Corp., Menlo Park, CA USA
NASA DC-8 Airborne Scanning Lidar Cloud and Contrail Observations
Uthe, Edward E., SRI International Corp., USA; Oseberg, Terje E., SRI International Corp., USA; Nielsen, Norman B., SRI International Corp., USA; Jun. 1997; 4p; In English
Contract(s)/Grant(s): NCC2-885
Report No.(s): NASA-CR-205130; NAS 1.26:205130; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

An angular scanning backscatter lidar has been developed and operated from the NASA DC-8 aircraft; the lidar viewing direction could be scanned from vertically upward to forward in the direction of aircraft travel to vertically downward. The scanning lidar was used to generate real-time video displays of clouds and contrails above, below, and ahead of the aircraft to aid in positioning the aircraft for achieving optimum cloud/contrail sampling by onboard in situ samplers. Data examples show that the lidar provides unique information for the interpretation of the other data records and that combined data analyses provides enhanced evaluations of contrail/cloud structure, dynamics, composition, and optical/radiative properties.
Author
Optical Radar; Backscattering; DC 8 Aircraft; Clouds (Meteorology); Contrails; Real Time Operation; Airborne Equipment

19970026119 NASA Lewis Research Center, Cleveland, OH USA
Chemical Gas Sensors for Aeronautic and Space Applications
Hunter, Gary W., NASA Lewis Research Center, USA; Chen, Liang-Yu, National Academy of Sciences - National Research Council, USA; Neudeck, Philip G., NASA Lewis Research Center, USA; Knight, Dak, Cortez 3 Service Corp., USA; Liu, Chung-Chiun, Case Western Reserve Univ., USA; Wu, Quing-Hai, Case Western Reserve Univ., USA; Zhou, Huan-Jun, Case Western Reserve Univ., USA; Jun. 1997; 14p; In English; Sensors Expo 1997, 12-15 May 1997, Boston, MA, USA; Sponsored by Sensors Magazine, USA
Contract(s)/Grant(s): RTOP 242-20-00
Report No.(s): NASA-TM-107444; NAS 1.15:107444; E-10714; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Aeronautic and space applications require the development of chemical sensors with capabilities beyond those of commercially available sensors. Two areas of particular interest are safety monitoring and emission monitoring. In safety monitoring, detection of low concentrations of hydrogen at potentially low temperatures is important while for emission monitoring the detection of nitrogen oxides, hydrogen, hydrocarbons and oxygen is of interest. This paper discusses the needs of aeronautic and space applications and the point-contact sensor technology being developed to address these needs. The development of these sensors is based on progress in two types of technology: (1) Micromachining and microfabrication technology to fabricate miniaturized sensors. (2) The development of high temperature semiconductors, especially silicon carbide. The detection of each type of gas involves its own challenges in the fields of materials science and fabrication technology. The number of dual-use commercial applications of this microfabricated gas sensor technology make this general area of sensor development a field of significant interest.
Author
Aeronautics; Space Exploration; Gas Detectors; Hydrocarbons; Micromachining; Miniaturization

19970026138 NASA Lewis Research Center, Cleveland, OH USA
Damping Experiment of Spinning Composite Plates with Embedded Viscoelastic Material
Mehmed, Oral, NASA Lewis Research Center, USA; Kosmatka, John B., California Univ., USA; Physics and Process Modeling (PPM) and Other Propulsion R and T; Apr. 1997; Volume 2; 14p; In English; Also announced as 19970026130
Contract(s)/Grant(s): NCC3-309; NCC3-493
Report No.(s): Paper-28; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

One way to increase gas turbine engine blade reliability and durability is to reduce blade vibration. It is well known that vibration reduction can be achieved by adding damping to metal and composite blade-disk systems. This experiment was done to investigate the use of integral viscoelastic damping treatments to reduce vibration of rotating composite fan blades. It is part of a joint research effort with NASA LeRC and the University of California, San Diego (UCSD). Previous vibration bench test results obtained at UCSD show that plates with embedded viscoelastic material had over ten times greater damping than similar untreated

plates; and this was without a noticeable change in blade stiffness. The objectives of this experiment, were to verify the structural integrity of composite plates with viscoelastic material embedded between composite layers while under large steady forces from spinning, and to measure the damping and natural frequency variation with rotational speed.
Derived from text
Viscoelastic Damping; Structural Failure; Stiffness; Plates (Structural Members); Gas Turbine Engines; Fan Blades

19970026139 NASA Lewis Research Center, Cleveland, OH USA
Magnetic Excitation for Spin Vibration Testing
Johnson, Dexter, NASA Lewis Research Center, USA; Mehmed, Oral, NASA Lewis Research Center, USA; Brown, Gerald V., NASA Lewis Research Center, USA; Physics and Process Modeling (PPM) and Other Propulsion R and T; Apr. 1997; Volume 2; 10p; In English; Also announced as 19970026130
Report No.(s): Paper-29; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The Dynamic Spin Rig Laboratory (DSRL) at the NASA Lewis Research Center is a facility used for vibration testing of structures under spinning conditions. The current actuators used for excitation are electromagnetic shakers which are configured to apply torque to the rig's vertical rotor. The rotor is supported radially and axially by conventional bearings. Current operation is limited in rotational speed, excitation capability, and test duration. In an effort to enhance its capabilities, the rig has been initially equipped with a radial magnetic bearing which provides complementary excitation and shaft support. The new magnetic feature has been used in actual blade vibration tests and its performance has been favorable. Due to the success of this initial modification further enhancements are planned which include making the system fully magnetically supported. This paper reports on this comprehensive effort to upgrade the DSRL with an emphasis on the new magnetic excitation capability.
Author
Shafts (Machine Elements); Magnetic Bearings; Actuators; Rotors; Spin Tests; Torque; Vibration

19970026144 NASA Lewis Research Center, Cleveland, OH USA
The Role of Tribology in the Development of an Oil-Free Turbocharger
Dellacorte, Christopher, NASA Lewis Research Center, USA; Physics and Process Modeling (PPM) and Other Propulsion R and T; Apr. 1997; Volume 2; 4p; In English; Also announced as 19970026130
Report No.(s): Paper-34; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Gas-turbine-based aeropropulsion engines are technologically mature. Thus, as with any mature technology, revolutionary approaches will be needed to achieve the significant performance gains that will keep the U.S. propulsion manufacturers well ahead of foreign competition. One such approach is the development of oil-free turbomachinery utilizing advanced foil air bearings, seals, and solid lubricants. by eliminating oil-lubricated bearings and seals and supporting an engine rotor on an air film, significant improvements can be realized. For example, the entire oil system including pipes, lines, filters, cooler, and tanks could be removed, thereby saving considerable weight. Since air has no thermal decomposition temperature, engine systems could operate without excessive cooling. Also, since air bearings have no diameter-rpm fatigue limits (D-N limits), engines could be designed to operate at much higher speeds and higher density, which would result in a smaller aeropropulsion package. Because of recent advances in compliant foil air bearings and high temperature solid lubricants, these technologies can be applied to oil-free turbomachinery. In an effort to develop these technologies and to demonstrate a project along the path to an oil-free gas turbine engine, NASA has undertaken the development of an oil-free turbocharger for a heavy duty diesel engine. This turbomachine can reach 120000 rpm at a bearing temperature of 540 C (1000 F) and, in comparison to oil-lubricated bearings, can increase efficiency by 10 to 15 percent because of reduced friction. In addition, because there are no oil lubricants, there are no seal-leakage-induced emissions.
Derived from text
Tribology; Turbocompressors; Turbomachinery; Solid Lubricants; Lubricants; High Temperature Lubricants; Gas Turbine Engines; Gas Bearings; Elastic Properties; Aircraft Engines

19970026147 Army Research Lab., Cleveland, OH USA
Recent Advances in the Analysis of Spiral Bevel Gears
Handschuh, Robert F., Army Research Lab., USA; Physics and Process Modeling (PPM) and Other Propulsion R and T; Apr. 1997; Volume 2; 16p; In English; Also announced as 19970026130
Report No.(s): Paper-37; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Spiral bevel gears are currently used in all helicopter power transmission systems manufactured in the USA. These gears are required to transfer power from the horizontal engines to the vertical rotor shaft. Spiral bevel gears used in this capacity, are typically required to carry high loads and operate at very high rotational speeds. The requirements of a typical aerospace spiral bevel

gear application is shown. When designers are faced with requirements outside of their experience, failures can occur or the resultant design will not be optimal. Therefore analytical tools that can enhance the design process are needed. Over the last ten years many studies have been conducted on understanding, analyzing, and improving the surface geometry and meshing characteristics of spiral bevel gears. Research in this area requires understanding and kinematically representing the manufacturing process. The basic configuration of the machine for manufacture of spiral bevel gears is shown. Building on the very important fundamentals of gear manufacturing kinematics has permitted the extension of these techniques to produce 3-D finite element models. Utilizing this numerical technique has resulted in sophisticated analysis of these complex gears for thermal and structural/contact analysis. The objective of this paper is to summarize the differential geometry approach to modeling the gear tooth surface geometry, document how three-dimensional models are developed, and provide examples using the finite element technique for solving thermal and structural/contact problems.
Derived from text
Helicopter Propeller Drive; Shafts (Machine Elements); Transmissions (Machine Elements); Gear Teeth; Rotors

19970026200 Defence Science and Technology Organisation, Airframes and Engines Div., Canberra, Australia
Signal Processing Methods for Gearbox Fault Detection
Rofe, Simon, Defence Science and Technology Organisation, Australia; Feb. 1997; 44p; In English
Report No.(s): AD-A324101; DSTO-TR-0476; DODA-AR-010-104; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Methods of accounting for load variation in vibration signals from helicopter transmission systems are presented. These methods are based on autoregressive moving-average (ARMA) models, and several ARMA parameter estimation schemes are presented. Simulations of load variation are carried out, and a prediction error filter, based on the ARMA models, is used to generate a residual signal. Fault indices extracted from the residential signal are used to indicate the presence or absence of a fault. The results of the simulations suggest that this method of fault detection is able to detect both general and local fault conditions.
DTIC
Helicopter Propeller Drive; Transmissions (Machine Elements); Fault Detection; Engine Monitoring Instruments; System Failures; Systems Health Monitoring; Gears; Signal Processing; Vibration; Load Distribution (Forces)

19970026240 Defence Science and Technology Organisation, Airframes and Engines Div., Canberra, Australia
Elastic-Plastic Analysis of a Plate of Strain Hardening Material with a Central Circular Hole: Comparison of Experiment with Finite Element Analysis Containing the Unified Constitutive Material Model
Allan, Robert B., Defence Science and Technology Organisation, Australia; Feb. 1997; 47p; In English
Report No.(s): AD-A324100; DSTO-TR-0492; DODA-AR-010-134; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents an experimental validation of elastic-plastic finite element stress analysis, using a unified constitutive model to describe the plastic response. The validation was done by experimentally measuring the elastic-plastic strain distribution around a circular hole in a flat plate under tensile loading and comparing it with that produced by a finite element analysis of the specimen using the unified constitutive model. The validation involved strain measurements using both strain gauges and full-field photoelasticity. The unified constitutive model was found to provide a significant improvement over classical plasticity modeling for the case of monotonic loading. A similar validation for cyclic plasticity has not yet been undertaken.
DTIC
Finite Element Method; Flat Plates; Holes (Mechanics); Perforated Plates; Strain Hardening; Strain Measurement; Stress Analysis; Plastic Deformation; Aircraft Maintenance; F-111 Aircraft; Structural Analysis

19970026368 Fluid Gravity Engineering Ltd., Liphook, UK
Heat Transfer for Perfect Gas and Chemically Reacting Flows
Smith, Arthur, Fluid Gravity Engineering Ltd., UK; May 1995; 14p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In this section we focus on basic principles and the derivation of some basic relationships used in heat transfer analysis for planetary entry. Catalytic mechanisms and their effect on the thermal protection system is considered, finally radiation transport and regimes are briefly examined.
Author
Reacting Flow; Atmospheric Entry; Ideal Gas; Thermal Protection; Aerodynamic Heating; Heat Transfer; Radiation Transport; Aerothermodynamics

19970026375 Aerospatiale, Dept. Aerodynamique and Electromagnetisme, Les Mureaux, France
Communication Blackout During Earth-Atmosphere Entry of Capsules
Boukhobza, M., Aerospatiale, France; May 1995; 8p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Communication blackout that occurs when space capsules enter the earth atmosphere is discussed. This paper has three sections. The first section describes: the communication blackout phenomenology, computer programs used at Aerospatiale Espace & Defence to predict the plasma characteristics, and the radioelectric attenuations effects in communication blackout. The second section deals with altitude ranges and encountered problems during the atmosphere entry of capsules. Examples of communication blackout observed during entry of APOLLO and SOYOUZ vehicles are summarized in the last section.
CASI
Atmospheric Entry; Blackout (Propagation); Plasma Sheaths; Reentry Communication; Boundary Layer Plasmas; Space Capsules; Hypersonic Reentry; Aerodynamic Heating

19970026376 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
Ablation
Devezeaux, D., Office National d'Etudes et de Recherches Aerospatiales, France; Hollanders, H., Aerospatiale, France; May 1995; 10p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

When a vehicle is entering atmosphere at very large speeds, typically more than 4000 m/s, the mixture of gas which surrounds the body is heated by compression mechanisms at its front, and by friction inside the boundary layer. The temperature gradients are strong enough to induce some large energy transferred through the wall. One has to characterize the stiffness of this environment by the heat flux, an hypothetic wall at arbitrary temperature will receive, when isolated from the surrounding flowfield. This heat flux is depending on the velocity, altitude, shape geometry, and local point to be considered. For a ballistic re-entry body, which has a drag force quite small with respect to its weight, large velocity values are achieved until low altitude where density is rather high. The heat fluxes could reach values up to several hundred of MW/sq m, for an isolated wall. None material can resist to such heating. So, it needs the use of ablative materials, which disappear by means of physico-chemical processes with air.
Author
Ablation; Reentry Vehicles; Atmospheric Entry; Thermal Protection; Ablative Materials; Walls; Heat Flux; Aerodynamic Heating; Reentry Shielding; Spacecraft Shielding

19970026380 Advisory Group for Aerospace Research and Development, Aerospace Medical Panel, Neuilly-Sur-Seine, France
Audio Effectiveness in Aviation ***L'Efficacite des Communications Vocales en Aeronautique***
Audio Effectiveness in Aviation; Jun. 1997; 370p; In English; In French, 7-10 Oct. 1996, Copenhagen, Denmark; Also announced as 19970026381 through 19970026417
Report No.(s): AGARD-CP-596; ISBN-92-836-0043-6; Copyright Waived; Avail: CASI; A16, Hardcopy; A03, Microfiche

These proceedings include the Technical Evaluation Report, a Keynote Address, three overview addresses of key technical areas, 34 solicited papers, and a Summary paper of the Symposium sponsored by the AGARD Aerospace Medical Panel held in Copenhagen, DE, from 7-11 October 1996. Topics addressed during this Symposium were: Audio Displays Noise Control, Passive Technique Noise Control, Active Technique Noise Control, Applications Communication in Stressful Environment, and Voice Control.
Author
Aerospace Medicine; Conferences; Noise Reduction; Voice Communication; Human Factors Engineering; Aircraft Noise; Cockpits; Voice Control; Auditory Perception

19970026381 Defence Research Agency, Systems Integration Dept., Farnborough, UK
The Audio Environment in Aircraft
Rood, Graham, Defence Research Agency, UK; Jun. 1997; 10p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The overall aim of much of the Acoustic & Noise research is to minimize the risk of hearing damage whilst maximizing the operational communications capability, with communications meaning all necessary signals to the pilots' ear. Calculations show that by using next generation active noise reduction technology in the flying helmet, producing higher levels of active reduction or combinations of active & passive attenuation, it is possible to reduce the noise levels at the pilots ear to around 75 dB, such that the hearing damage risk is essentially reduced to zero. The reduction of noise levels at the ear is also fully compatible with improving speech & non-speech communications. At the talker & signal input end - at the microphone - signal processing approaches are needed to provide adequate signal to noise ratios for transmission, not only for the reception by humans, but also

for the recognition by machines, whether they are part of a human centered system (e.a. Vocoder) or a machine centered system (e.g. Voice Recognition Systems). At the listening end, research into means of noise reduction, either active or passive - or, more likely, and tested Auditory Icons, will require the use of higher quality transducers in the helmet earshell, as will the use of good performance ANR, and this will support the move towards higher speech intelligibility. Overall, the progress of technology and computing, that is now available in the acoustics arena, will provide a strong capability to allow the enhancement of operational crew performance by the use of the auditory mode as a synergistic supplement to the more heavily utilized visual senses.
Derived from text
Noise Reduction; Auditory Perception; Human Factors Engineering; Aerospace Medicine; Aircraft Noise; Voice Communication; Cockpits; Pilots (Personnel); Helmets; Noise Intensity; Ear Protectors

19970026384 Wright State Univ., Dept. of Psychology, Dayton, OH USA
Design Considerations for 3-D Auditory Displays in Cockpits
Gilkey, Robert H., Wright State Univ., USA; Simpson, Brian D., Wright State Univ., USA; Isabelle, Scott K., Armstrong Lab., USA; Anderson, Timothy A., Armstrong Lab., USA; Good, Michael D., Honeywell Technology Center, USA; Jun. 1997; 10p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Potential cockpit applications of 3-dimensional auditory displays have generated considerable interest. These applications include: increasing speech intelligibility by spatially separating communication channels, providing a navigation beacon, directing pilots' attention to targets and threats, enhancing situational awareness by cuing a wingman's location or indicating an imminent collision, or even providing an auditory attitude indicator. However, cockpit noise and the complexity of the signals to be localized can adversely affect sound localization performance and may limit the effectiveness of these displays. We review the results of our experiments on sound localization in noise and the localization of speech signals with the head stationary, which indicate that although the ability to distinguish left from right can be quite accurate in adverse situations, often the accuracy of elevation judgments decreases and the number of front/back confusions increases with relatively small deviations from ideal conditions. The implications of these performance limitations for the design of auditory displays and potential strategies for enhancing performance will be discussed.
Author
Aircraft Pilots; Sound Localization; Auditory Perception; Cockpits; Display Devices; Position (Location); Voice Communication; Noise Reduction

19970026385 Sextant Avionique, Saint Medard en Jalles, France
Perceptual and Cognitive Synergy in Target Orientation: 3D Sound and Visual Information ***Synergie Perceptuelle et Cognitive dans l'Orientation vers une Cible: SON 3D et Information Visuelle***
Courneau, M., Sextant Avionique, France; Leppert, F., Sextant Avionique, France; Gulli, C., Sextant Avionique, France; Leger, A., Sextant Avionique, France; Pellieux, L., Centre d'Enseignement et de Recherches de Medecine Aeronautique, France; Haas, M., Armstrong Lab., USA; Jun. 1997; 6p; In French; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

In the experimentation described here, two types of information that can make it possible to locate a threat were studied in an aeronautical context. Visual information, consisting of an arrow pointing toward the threat, involving a relatively high-level cognitive mechanism, was presented on an HMD (fully feathering propeller). A more perceptual location aid, based on 3D sound, was used alternatingly or simultaneously. The study was conducted in the context of cooperation between Sextant Avionique, Armstrong Laboratory, and IMASSA/CERMA. The purpose was to evaluate the effectiveness of these two modes of information in a flight simulator and to test the hypothesis of a synergy between them. The results presented here relate more particularly to the phase of orientation toward the threat. The analysis of data received during the experiment shows that the visual and sound information is equivalent and that there is an additive synergy. This synergy is revealed by a significant improvement of the performances of the test subjects when the two modes are presented in an additive and simultaneous fashion.
Transl. by Schreiber
Flight Simulators; Target Acquisition; Position (Location); Visual Perception; Audio Equipment; Noise (Sound); Auditory Perception

19970026386 Institute for Human Factors TNO, Soesterberg, Netherlands
Evaluation of a Three-Dimensional Auditory Display in Simulated Flight
Bronkhorst, A. W., Institute for Human Factors TNO, Netherlands; Veltman, J. A., Institute for Human Factors TNO, Netherlands; Jun. 1997; 6p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Modern signal processing techniques allow headphone sounds to be processed in such a way that they seem to originate from virtual sound sources located in the three-dimensional space around the listener. by using head tracking devices, it is even possible to create a stable virtual acoustic environment that takes (head) movements of the listener into account. One interesting application of 3D sound is that it can be used to support situational awareness by generating virtual sound sources that indicate positions of relevant objects (e.g. targets or threats). This application was investigated in two flight simulation experiments in which the 3D auditory display, used as a radar display, was compared with 2D and 3D visual radar displays. A target localization task was employed, in which the subject, who flew a fighter aircraft, had to locate and follow another, suddenly appearing aircraft as quickly as possible. Dependent variables were the search time and a subjective workload score, obtained after each trial. In the second experiment, also the deviation from the optimal track toward the target and the performance on a secondary task were scored. Results show that search times and workload are similar for 3D auditory and 2D visual displays. Search times for the 3D visual display were smaller. Simultaneous presentation of auditory and visual displays gave clearly improved performance in case of the 2D visual display, but only minimal improvement with the 3D visual display. The results demonstrate the effectiveness of a 3D auditory display used as a radar display, but indicate that further development is required to reach the performance level of advanced 3D visual displays.
Author
Earphones; Display Devices; Fighter Aircraft; Flight Simulation; Noise (Sound); Auditory Perception; Signal Processing; Man Machine Systems; Cockpits; Sound Generators

19970026408 German Air Force, Otorhinolaryngology Dept., Fuerstenfeldbruk, Germany
Speech Language Hearing Test Results of Active Duty Pilots Failing the Pure Tone Audiometry Limits of ICAO Guidelines: Method, Problems and Limits to Verify the Waiver Status
Hanschke, W., German Air Force, Germany; Jun. 1997; 4p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

Adequate hearing is essential for communication in flight and rapid and accurate assessment of warning tones in the cockpit. Waiver is permitted, when hearing is adequate to permit essential communication in flight. The Freiburger speech language hearing test method gives the opportunity to verify the intelligibility in a standard proven manor with the possibility to add aviation related necessities. A higher safety standard could be refined by replacement of the former subjective aeromedical hearing methods.
Author
Audiometry; Speech Recognition; Voice Communication; Aircraft Pilots; Hearing; Noise Reduction; Auditory Perception; Languages; Auditory Defects

19970026409 Royal Norwegian Air Force, Inst. of Aviation Medicine, Oslo, Norway
Improved Speech Intelligibility in Aircraft Noise due to Altitude
Wagstaff, Anthony S., Royal Norwegian Air Force, Norway; Jun. 1997; 6p; In English; Also announced as 19970026380; Sponsored in part by Norwegian Air Ambulance; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Few studies have addressed effects of altitude and noise combined, although these two effects are inherent parts of all aviation. The few published studies that have addressed altitude effects on hearing function have mainly focused on using gas mixtures, and have demonstrated inconclusive results. The present study was designed to assess the effect of altitude on speech intelligibility in aircraft noise. The primary hypothesis was a predicted detrimental, hypoxic effect on speech intelligibility in noise. Eight male subjects with normal hearing were fitted with an aviation headset specially adapted for use with the audiometer. Pure-tone audiometry, as well as speech audiometry in noise, was performed at 0, 10,000, 13,000, and 16,000 ft. simulated altitudes in a hypobaric chamber. The 4 test altitudes were performed double blind with respect to audiometry operator and test subject. Arterial blood gases where measured using an intra-arterial catheter and tympanometric measurements verified full middle ear equilibration. Noise levels where monitored and logged throughout all experiments. A substantial increase in speech intelligibility in noise due to altitude was found in this study. The physical effect of barometric pressure on noise causing an increased signal-to-noise ratio was found to greatly outweigh any hypoxic detrimental effect.
Author
Aircraft Noise; Noise Intensity; Auditory Perception; Voice Communication; High Altitude Environments; Aerospace Medicine; Speech Recognition; Earphones; Hearing

19970026410 Armstrong Lab., Bioacoustics and Biocommunications Branch, Wright-Patterson AFB, OH USA
Vulnerability of Female Speech Produced in Operational Noises
Nixon, C. W., Armstrong Lab., USA; Morris, L. J., Armstrong Lab., USA; McCavitt, A. R., Armstrong Lab., USA; McDaniel,

M. P., Armstrong Lab., USA; Anderson, T. R., Armstrong Lab., USA; McKinley, R. L., Armstrong Lab., USA; Yeager, D. G., Armstrong Lab., USA; Jun. 1997; 12p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

This study quantified the speech intelligibility differences in high level noise due to gender. Female speech was always less intelligible than male speech and the differences grew with increased levels of the noise. Intelligibility of both male and female speech differed with aircraft noise spectrum. These gender differences caused no impact at the lower levels of noise, however they do constitute a problem at the highest levels. The application of active noise reduction technology and replacement of the M-87 with the M-169 noise canceling microphone should neutralize most of these impacts. The perception of LPC-10 and CVSD vocoded female speech was essentially the same as male speech. There were no significant differences between the recognition accuracy of male and female speech for either the ITT or IBM automatic speech recognition system.

Author

Speech Recognition; Sex Factor; Females; Aircraft Noise; Noise Reduction; Voice Communication; Noise Intensity

19970026412 MRC Applied Psychology Unit, Cambridge, UK

Vocal Agitation as a Predictor of Emotion and Stress

Allerhand, M. H., MRC Applied Psychology Unit, UK; Patterson, R. D., MRC Applied Psychology Unit, UK; Jun. 1997; 10p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper reports an application of a computational auditory model to measure vocal agitation in speech automatically, and to relate it to the perceived stress in recordings of pilots operating under adverse conditions. Results of a short-time correlational experiment show significant correlation ($r = 0.765$; p is less than .001) between measured and perceived vocal agitation. It is also shown that time-integrated vocal agitation corresponds well with perceived stress over a period of the order of 18s.

Author

Voice Communication; Auditory Perception; Mathematical Models; Aircraft Pilots; Acoustics; Aircraft Noise; Agitation

19970026413 Defence Research Agency, Systems Integration Dept., Farnborough, UK

Effects of Helicopter Cabin Noise Upon HF Vocoder Secure Speech Systems

Rogers, I. E. C., Defence Research Agency, UK; Rood, G. M., Defence Research Agency, UK; Jun. 1997; 10p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

An increasing number of military aircraft are being provided with secure (encrypted) systems for air-to-air, air-to-ground and ground-to-air communications. Most secure HF radio channels use a Linear Predictive Coder (LPC-10 Vocoder) to parameterize the talker's speech, and this digital data is then encrypted before being transmitted over the HF radio link. At the receiver, the data is decrypted and fed into a second vocoder, where the speech parameters transmitted are used to produce a representation of the original speech signal. The vocoders transmit the digitized data at 2.4kbits/sec according to the NATO STANAG 4198 interoperability standard. Studies at DRA Farnborough have identified that the presence of helicopter noise at the microphone input to the transmitting vocoder reduces the intelligibility of the vocoded speech transmitted, and that the reduction is dependent on the relative levels of the speech and noise at the microphone (i.e. the speech to noise ratio, SNR). These assessments have been conducted using Diagnostic Rhyme Test (DRT) techniques. DRA have investigated techniques to enhance the performance of vocoders using digital processing techniques. DRT and user acceptability assessment trials have been conducted to assess the effects of these techniques on LPC-10 vocoder performance and the results of this work will be presented.

Author

Military Aircraft; Aircraft Noise; Digital Data; Helicopters; Aircraft Compartments; Voice Communication; Noise Reduction; Vocoders; Radio Communication; Voice Data Processing

19970026415 Defence Research Agency, Systems Integration Dept., Farnborough, UK

Voice Recognition in Adverse Aircraft Cockpit Environments

South, A. J., Defence Research Agency, UK; Jun. 1997; 10p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

A speech recognition system has been flown in a two seat Tornado strike aircraft and assessments made of the recognition accuracy under normal, terrain following and 4G turning flight. Word accuracies averaged some 96% under normal flight, and 95% under terrain following. During 4G turns the recognition levels dropped to around 80%. Subsequent speech recordings made on the centrifuge at the RAF School of Aviation Medicine consisted of lists of digit strings and typical Direct Voice Input command phrases. Recordings were made at up to 8G, using four different levels of anti-G protection. The subjects were five male RAF personnel, and one female. The digit string lists were used to test a speaker-dependent whole word speech recognizer at up to 6G.

The results will be presented for protection using standard and full coverage anti-G garments, and with the use of positive pressure breathing. Possible solutions to the lower accuracy rates at higher G levels and with pressure breathing are discussed.
Author
Speech Recognition; Military Aircraft; Aircraft Pilots; Auditory Perception; Voice Communication; Cockpits; Gravitational Physiology; Gravitational Effects

19970026416 Wright Lab., Vehicle-Pilot Integration Branch, Wright-Patterson AFB, OH USA
Flight Test Performance Optimization of ITT VRS-1290 Speech Recognition System
Williamson, David T., Wright Lab., USA; Barry, Timothy P., Wright Lab., USA; Liggett, Kristen K., Wright Lab., USA; Jun. 1997; 6p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper discusses the performance optimization of an ITT VRS-1290 continuous speech, speaker dependent speech recognition system that was flight tested in a NASA Lewis Research Center OV-10A aircraft. A 53-word vocabulary was tested with twelve pilots using an M-162 microphone headset on the ground and under 1g and 3g flight conditions. Digital Audio Tape (DAT) recordings were made of both the subjects' input and ambient background noise. Noise levels in the rear cockpit were in excess of 115 dB, with signal-to-noise ratios measured as low as 12 dB. During the early stages of the flight test, performance of the ITT system was poor, with some subjects achieving below 60% recognition accuracy. The DAT recordings became a critical element in the troubleshooting and optimization of the ITT system. A combination of input gain. noise calibration, and ITT recognizer engineering parameters were adjusted based on DAT testing to achieve an average word accuracy of 97.7% in the 1g condition and 97.1% in 3g across all subjects.
Author
Speech Recognition; Flight Tests; Gravitational Effects; Background Noise; Flight Conditions; Microphones; Voice Communication; Aircraft Pilots; Earphones

19970026417 Abertay Univ., Div. of Psychology, Dundee, UK
Hidden Usability Issues in Speech Interfaces
Cook, Malcolm J., Abertay Univ., UK; Cranmer, Charles, Abertay Univ., UK; Milton, Carol-Ann, Abertay Univ., UK; Finan, Robert, Abertay Univ., UK; Sapeluk, Andy, Abertay Univ., UK; Jun. 1997; 30p; In English; Also announced as 19970026380; Sponsored in part by European Social Fund; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The increasing power and sophistication of speech recognition and speech synthesis has encouraged speculation that human factors problems in implementing speech interfaces will diminish dramatically as technological develops. Advanced speech interfaces have been investigated and are currently being integrated into prototypes for advanced civil and military cockpits. The reason for the introduction of speech-based interfaces is to increase the time available for head-up flight and, thereby, to improve flight performance and safety. The advantage which is claimed for delivering information via speech-based interfaces is a reduction the vast quantities of information normally presented in visual displays in the cockpit and the release of the pilot from head down management of cockpit systems. Directly or indirectly, the benefits of splitting information delivery and data command/entry across modalities are often justified in terms of independent information processing. The independent nature of the processing in turn assumes there will be no interference between tasks or degradation in performance. Pilot research by the authors indicates that there are problems related to memory and workload that are present in current technology and will remain in future solutions with speech-based interfaces. These problems will remain in even though recognition accuracy is increased because they reside in the limits of the human operator to manage multi model environments. In a simulated multi-task environment self-reports and performance a moderate to high levels workload workload with multi-model interfaces have shown that overall performance with speech-based interfaces is degraded. The use of multi-model interfaces resulted in degraded performance on tasks requiring extended processing of information and recall of information from memory.
Author
Speech Recognition; Voice Communication; Aircraft Instruments; Voice Control; Cockpits; Display Devices; Man Machine Systems

19970026630 Defence Research Establishment Ottawa, Ottawa, Ontario Canada
Effect of Repair on the Electromagnetic Shielding Properties of Composite Materials
Gardner, C. L., Defence Research Establishment Ottawa, Canada; Apps, R., Defence Research Establishment Ottawa, Canada; Russell, A. J., Esquimalt Defence Research Detachment, Canada; Jan. 1997; 21p; In English
Report No.(s): AD-A325402; DREO-TN-97-001; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Composite materials are increasingly being used for the construction of aircraft because of their superior physical properties. Maintenance of adequate electromagnetic (EM) shielding inside the aircraft is often a concern because of the increasing use of sensitive avionics. Degradation of EM shielding provided by the skin of the aircraft during repair can be of particular concern. In this report, we present results of measurements that we have made to examine the effect of repair on the magnetic and electric shielding properties of carbon/epoxy laminates. In carrying out this study, we have used the conventional repair techniques that are used for repair of the CF-18 aircraft. These methods include the application of epoxy bonded carbon/epoxy and titanium patches, and the use of a bolted aluminum rapid repair (battle) patch. In all cases the patches were applied over a 75 mm hole in an 8-ply AS-4 carbon/epoxy laminate. The results show that the use of a carbon/epoxy or a titanium patch results in a degradation of the magnetic shielding of the carbon/epoxy laminates by as much as 40 dB. This large degradation is attributed to the loss of electrical contact between the patch material and the laminate. The degradation of magnetic shielding with a bolted aluminum patch is less severe (20 dB) because the bolts provide some electrical contact between the patch and the laminate. Similar results are presented for the effect of repair on electrical shielding. Limited results are presented that show that shielding can be substantially improved by providing electrical contact between the laminate and the patch material.
DTIC
Electromagnetic Shielding; Epoxy Matrix Composites; Laminates; Avionics; Carbon Fiber Reinforced Plastics; Aircraft Construction Materials; Aircraft Maintenance

19970026665 Defence Research Agency, Malvern, UK
An Advanced Numerical Scheme for Computational Electromagnetics
Gallagher, J. G., Defence Research Agency, UK; Hodgetts, T. E., Defence Research Agency, UK; Lytton, C. C., Defence Research Agency, UK; Arthur, M. T., Defence Research Agency, UK; King, I. D., Defence Research Agency, UK; Apr. 1997; 10p; In English; Also announced as 19970026663; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Computational electromagnetics and computational fluid dynamics have evolved as independent areas of numerical analysis, but the equations which are solved in these two areas are fundamentally similar. It therefore seems plausible that methods developed in one area should also be applicable to the other, with possible savings of time and computer resources. This paper describes a test of this idea: a general method originally developed for aerodynamics calculations by specialists at the farnborough site of the Defence Research Agency (DRA) is now being adapted for electromagnetic calculations, with the collaboration of specialists at the DRA's Malvern site. The preliminary results are very encouraging.
Author
Computational Electromagnetics; Numerical Analysis; Aerodynamics

19970026826 Stanford Univ., Mechanical Engineering Dept., Stanford, CA USA
Research on Supersonic Reacting Rows ***Final Report, 15 Feb. 1994 - 15 Feb. 1997***
Bowman, C. T., Stanford Univ., USA; Hanson, R. K., Stanford Univ., USA; Mungal, M. G., Stanford Univ., USA; Reynolds, W. C., Stanford Univ., USA; Feb. 14, 1997; 48p; In English
Contract(s)/Grant(s): F49620-94-I-0152; AF Proj. 2308
Report No.(s): AD-A326209; AFOSR-TR-97-0273; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An experimental and computational investigation of supersonic combustion flows was carried out. The principal objective of the research was to gain a more fundamental understanding of mixing and chemical reaction in supersonic flows. The research effort comprised three inter-related elements: (1) stability analyses and numerical simulations of compressible reacting flows; (2) development of laser-induced fluorescence techniques for time-resolved multidimensional imaging of species concentration, temperature, velocity and pressure; and (3) an experimental study of mixing and combustion in a supersonic plane mixing layer with the additional development of simple mixing enhancements. The specific objectives and results of the research of each of these program elements have been summarized in this report. New results include: a detailed stability map for reacting, compressible shear layers; new PLIF techniques for transient facilities; new measurements of mixing efficiency in compressible flows and demonstration of simple mixing enhancement techniques with low pressure drop.
DTIC
Supersonic Combustion; Supersonic Flow; Compressible Flow; Laser Induced Fluorescence; Shear Layers

19970026835 Arizona Univ., Dept. of Aerospace and Mechanical Engineering, Tucson, AZ USA
Receptivity Theory in Compressible Jet Flow Control ***Final Report***
Kerschen, Edward J., Arizona Univ., USA; Mar. 1997; 28p; In English
Contract(s)/Grant(s): F49620-94-I-0206
Report No.(s): AD-A325563; AFOSR-97-0160TR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An analysis is presented for the generation of shear layer instability waves by localized sources close to and far from the trailing edge. The frequency is assumed low enough that the shear layer can be represented by a vortex sheet, and the solution is developed using the Wiener-Hopf technique. Actuators (sources) on both surfaces of the splitter plate, and in the quiescent fluid just outside the shear layer, are considered. Results are presented for both subsonic and supersonic Mach numbers. Actuators on the stream side of the splitter place are found to be more effective in generating shear layer instability waves than actuators on the side adjacent to the quiescent fluid. The receptivity is highest for actuators located very near the trailing edge. For upstream actuators located on or near the splitter plate surface, the receptivity level decreases algebraically with distance from the trailing edge. In contrast, for actuators located just outside the shear layer downstream of the trailing edge, the receptivity level decreases exponentially with distance from the trailing edge.
DTIC
Jet Flow; Surface Stability; Aerodynamic Characteristics; Controllability

13
GEOSCIENCES

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

19970026354 Universal Energy Systems, Inc., Dayton, OH USA
Thermal Management Research Studies, Volume 2, Rotating Hear Pipe ***Final Report, Mar. 1991 - Aug. 1996***
Ponnappan, Rengasamy, Universal Energy Systems, Inc., USA; Sep. 17, 1996; 217p; In English
Contract(s)/Grant(s): F33615-91-C-2104; AF Proj. 3145
Report No.(s): AD-A325412; UES-255-TR-96-1-Vol-2; WL-TR-97-2002-Vol-2; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This document presents a comprehensive account of the high speed rotating heat pipe (RHP) research performed in support of the more electric airplane technology development. A literature review revealed that there are no studies done on RHP at rotational speeds above 12,000 rpm. New trends in advanced IPU (Integrated Power Unit) and IS/G (Integral Starter/Generator) type of systems require very high speeds up to 60,000 rpm in order to be directly coupled to the gas turbine engines used in aircraft. RHP technology may be a viable method for the thermal management of these power systems. RHP test articles have been designed, fabricated and tested successfully in the high speed test rig developed especially for this purpose. Water and methanol filled RHPs made of stainless steel were tested up to 30,000 rpm for the first time. Some deficiencies in the existing analytical modeling of the RHP performance were identified and improvement directions were initiated. Several unique design and testing scenarios, such as critical speed, and dynamic balancing aspects, non-contact temperature measurement, induction heating, oil jet cooling, etc. are presented. Air jet cooling of the RHP condenser looks attractive for low heat transport capacity applications as opposed to the oil jet cooling which requires rotary shaft seals.
DTIC
Heat Pipes; Gas Turbine Engines; Fabrication; Heat Transfer; Induction Heating; Temperature Control; Aircraft Engines; Thermal Analysis; Liquid Cooling; Air Cooling

14
LIFE SCIENCES

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

19970026184 Army Aeromedical Research Lab., Fort Rucker, AL USA
U.S. Army's Aviation Life Support Equipment Retrieval Program ***Final Report***
Voisine, Joel J., Army Aeromedical Research Lab., USA; Licina, Joseph R., Army Aeromedical Research Lab., USA; McEntire, B. J., Army Aeromedical Research Lab., USA; Apr. 1997; 50p; In English
Contract(s)/Grant(s): 30162787A878
Report No.(s): AD-A324959; USAARL-97-16; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In 1972, the U.S. Army Aeromedical Research Laboratory (USAARL) established the Aviation Life Support Equipment Retrieval Program (ALSERP). The purpose of this program is to evaluate the effectiveness of aviation protective equipment in an aircraft accident environment and to contribute to the improvement of this equipment through modification or development of new design criteria. Department of the Army Pamphlet 385-40, Army Accident Investigation and Reporting, requires all life sup-

port equipment which is in any way implicated in the cause or prevention of injury to be shipped to USAARL for analysis. The primary objectives of the ALSERP are: (1) to determine why aviation mishap occupant injuries were or were not received, and (2) to develop concepts and criteria for design improvements through the analysis of injuries and their correlation to retrieved aviation life support equipment.
DTIC
Accident Investigation; Aircraft Accidents; Life Support Systems; Injuries

19970026205 Syracuse Univ., Inst. for Sensory Research, NY USA
Design and Implementation of the Tactor Array Controller Tool *Final Report*
Bolanowski, Stanley J., Syracuse Univ., USA; Feb. 08, 1996; 19p; In English
Contract(s)/Grant(s): N00014-95-I-0526
Report No.(s): AD-A325173; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Basically, the project was a one time contract to design and build a specific piece of equipment to show feasibility of a system that would improve situational awareness for pilots and other Navy personnel whose sensory systems are overtaxed or receiving conflicting information. The primary interest in developing such a device for the Navy is to aid in decreasing the number of aircraft and pilots lost during warfare and while flying under conditions that corrupt situational awareness. Our portion of the project involved hardware and software design of a device to interface between the output of a gyroscope and the input to a tact or array. The tactor array consisted of tactors that are mounted on a body suit which the pilot wears. The gyroscopic information is fed into the controller which uses a lookup table, programmable via Labview software and located in Read Only Memory (ROM), to map orientation of the gyroscope to particular patterns of vibration in the tactor array. The device has was designed and built and sent to the Naval Air Medical Research Laboratory in Pensacola, FL, and was to be used in a test flight sometime in the middle of August, 1995.
DTIC
Design Analysis; Arrays; Feasibility; Flight Safety; Physiological Effects; Disorientation; Human-Computer Interface

19970026234 Clemson Univ., SC USA
The Effects of Status, Cost, and Authoritoianism on Subordinate's Challenging/Monitoring Behavior in a Cockpit Simulation
Carey, Sean K., Clemson Univ., USA; Apr. 16, 1997; 109p; In English
Report No.(s): AD-A323878; AFIT/CI-97-014; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This research examined the challenging/monitoring communications behavior of 60 college undergraduates fulfilling the role of copilot in a cockpit simulation. The status of the pilot and cost of not challenging/monitoring the pilot's performance were manipulated. The number of task relevant communications, timing of these communications, and type of communications made by the subjects and directed at the pilot were measured. A measure of authoritarianism was also accomplished by the subjects. The results showed a significant status by cost interaction for the number and timing of communications variables. Subjects paired with low status pilots were more aggressive in their communications behavior under conditions of high cost than low cost of not challenging/monitoring. Subjects paired with high status pilots were more aggressive under conditions of low cost than high cost of not challenging/monitoring. Also, subjects paired with low status pilots used more direct styles of communication than those paired with high status pilots. These findings imply that when a copilot is paired with a high status pilot who makes a serious mistake, he/she is least likely to be aggressive in challenging such an error. In other words, copilots are most passive when their input is needed the most. Such findings have training, performance and safety implications.
DTIC
Aircraft Pilots; Cockpits; Flight Simulation; Voice Communication; Cockpit Simulators

19970026383 Armstrong Lab., Noise Effects Branch, Wright-Patterson AFB, OH USA
The Effects of Spatial Auditory Preview on Visual Performance
Elias, Bartholomew, Armstrong Lab., USA; Jun. 1997; 8p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Since the auditory system is not spatially restricted like the visual system, spatial auditory cues can provide information regarding an object's position, velocity, and trajectory beyond the field of view. Recent studies (e.g., Perrott, Cisneros, McKinley, & D'Angelo, 1995) have demonstrated performance benefits in static visual search tasks over large spatial extents when visual targets have been augmented with spatial auditory position cues. The benefits of spatial auditory display augmentation have also been demonstrated in applied settings such as airborne traffic collision avoidance systems (Begault, 1993). Research has also shown that spatial auditory displays are potentially useful for enhancing cockpit situational awareness and reducing visual work-

load in tactical aircraft operations (McKinley. et al., 1994). The research program described here adds to these initial findings regarding the utility of spatial auditory displays by demonstrating that visual displays can be augmented with dynamic spatial auditory preview cues that provide information regarding the relative position. velocity, and trajectory of objects beyond the field of view. In one experiment, the effects of a spatial auditory preview display were examined in a visual target aiming task. A moving sound source provided cues regarding the position and velocity of moving targets prior to their appearance on the visual display. by providing these spatial auditory preview cues, greater accuracy was achieved in the visual target aiming task. In a second experiment, dynamic spatial auditory cues presented through headphones conveyed preview information regarding target position, velocity, and trajectory beyond the field of view in a dynamic visual search task. The provision of spatial auditory preview cues significantly reduced response times to acquire and identify moving visual targets that traversed a cluttered display and significantly reduced error rates in target classification. These findings demonstrate that spatial auditory preview can augment visual displays and enhance performance in complex, dynamic task domains such as aviation.
Author
Display Devices; Audio Equipment; Cockpits; Collision Avoidance; Flight Operations; Visual Tasks; Auditory Perception; Auditory Signals

19970026396 Army Aeromedical Research Lab., Fort Rucker, AL USA
The Communications Earplug: A Logical Choice for Voice Communications in Aircraft
Mozo, Ben T., Army Aeromedical Research Lab., USA; Ribera, John E., Brooke Army Medical Center, USA; Audio Effectiveness in Aviation; Jun. 1997; 10p; In English; Also announced as 19970026380; Sponsored by Army Project Managers Office; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The U.S. Army aviator works in high levels of noise and routinely faces the challenge of effective voice communication. Existing aviator helmets, while adequate in providing hearing protection, do not provide the signal-to-noise ratio necessary to optimize in-flight voice communications. The Communications Earplug (CEP) is a small device worn by the aviator and provides significant improvements in hearing protection and communication performance. The CEP uses a miniature earphone transducer adapted to a replaceable foam earplug. Attenuation characteristics of the CEP are similar to those of other insert hearing protective devices and provide adequate protection in U.S. Army noise environments. Additional protection results when the CEP is worn with the aviator's helmet. The CEP is comfortable over a period of several hours and, in its current configuration, is considered highly acceptable by seasoned aviators and crewmembers. The CEP is easier to insert and seat in the outer ear canal than other insert protectors available through military channels. Speech intelligibility in simulated helicopter noise is significantly enhanced when using the CEP when compared to the standard SPH-4 and HGU-56/P aviator's helmets. CEP and active noise reduction (ANR) results are comparable in terms of speech intelligibility. However, there are several differences that should be considered before deciding which is the system of choice. The technology developed for CEP has wide-ranging application in the military and can easily be adapted to communication needs in the civilian community. The CEP is an inexpensive device that can enhance air and ground crewmember voice communications in the operational environment, and should be positively considered for inclusion into all aircraft and vehicular communication helmets as a battlefield multiplier for the 21st century.
Author
Aircraft Pilots; Earphones; Voice Communication; Noise Reduction; Helmets; Active Control; Hearing; Ear Protectors; Auditory Perception; Audio Equipment

19970026398 Centre d'Enseignement et de Recherches de Medecine Aeronautique, IMASSA, Bretigny, France
Assessment of Active Noise Reduction Hearing Protectors: Noise Attenuation and Speech Intelligibility ***Evaluation de Casques a Reduction Active de Bruit: Protection Auditive et Intelligibilite***
Pellieux, L., Centre d'Enseignement et de Recherches de Medecine Aeronautique, France; Sarafian, D., Centre d'Enseignement et de Recherches de Medecine Aeronautique, France; Reynaud, G., Sextant Avionique, France; Jun. 1997; 20p; In French; Also announced as 19970026380; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Hearing protection offered by current pilot helmets is far to be fully satisfying as shown by the large number of hearing losses observed in military aviators at retirement age. Due to the poor intelligibility of communication channels the sound volume has to be significantly increased which adds a dangerous auditory stressor. Eight hearing protectors such as commercially available active noise reduction (ANR) headsets and prototype helmets, equipped with ANR earshells, were assessed in order to estimate their efficacy for both noise attenuation and improvement on speech intelligibility. The assessment was based on original experimental protocols including abnormal conditions, objective measurement of both passive and active attenuations by the MIRE method, subjective prediction of intelligibility by measuring the Speech Transmission Index, and its subjective evaluation through

CVC tests. Realistic jet and helicopter noisy environments and a pink noise have been used to perform the tests. The results obtained with the various systems assessed are presented and discussed.
Author
Noise Reduction; Aircraft Pilots; Hearing; Ear Protectors; Noise Injuries; Speech Recognition; Earphones; Auditory Fatigue

19970026399 Royal Norwegian Air Force, Inst. of Aviation Medicine, Oslo, Norway
Effects of Active Noise Reduction on Noise Levels at the Tympanic Membrane
Wagstaff, A. S., Royal Norwegian Air Force, Norway; Woxen, O. J., Royal Norwegian Air Force, Norway; Jun. 1997; 6p; In English; Also announced as 19970026380; Sponsored in part by Norwegian Air Ambulance; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Active noise reduction (ANR) is an electronic system that works by continuous sampling of noise inside the earshell of the headset with a small microphone. This signal is inverted in phase through the headset speaker, thus reducing noise levels by destructive interference of the acoustic field. The system provides good low-frequency noise attenuation, but air crew differ in their subjective opinion of ANR. The present study is an attempt to provide an objective assessment of the effect of ANR on noise levels at the tympanic membrane. Seven subjects with normal ears were placed in an environment of recorded noise from a BO-105 helicopter. A microphone probe was inserted to within 5 mm of the tympanic membrane of each subjects right ear. Noise levels in the ear were measured without a headset and with two different ANR headsets. Measurements were performed with and without the ANR system on, and, with and without white noise through the headset communication system. The white noise was used to simulate aircraft communication noise. The two headsets tested had differing levels of passive and active attenuation. The ANR system produced a substantial low-frequency attenuation. However, noise levels in the mid frequencies increased somewhat when the ANR system was switched on. This effect was augmented when white noise in the communications system was introduced, particularly for one of the two headsets. Low-frequency noise attenuation of ANR systems is substantial, but an increased mid-and high frequency noise level caused by the ANR may affect both communication and overall noise levels. Our data provide advice on what factors should be taken into account when ANR is evaluated for use in an aviation operational environment.
Author
Aircraft Communication; Noise Reduction; Active Control; Acoustics; Continuous Noise; Earphones; Flight Crews; White Noise; Ear Protectors

19970026401 National Research Council of Canada, Ottawa, Ontario Canada
Adaptive Active Noise Reduction Headset for Helicopter Aircrew
Pan, G. J., National Research Council of Canada, Canada; Brammer, A. J., National Research Council of Canada, Canada; Crabtree, R. B., Defence and Civil Inst. of Environmental Medicine, Canada; Jun. 1997; 6p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The feasibility of applying adaptive active noise reduction (ANR) to a communication headset has been explored by applying digital feedforward control to a headset designed for helicopter aircrew. A miniature microphone was mounted on the outside of one circumaural earmuff to provide a reference signal, while the original microphone and earphone located within the volume enclosed by the earcup of a commercial ANR headset were retained to provide an 'error' signal and the corrective sound field, respectively. The signals were digitized and processed in real time by a TMS320C31 digital signal processor operating at 40 MHz. The performance of the apparatus has been evaluated in a reverberant room using a recording of Sea King helicopter noise at the aircrew position. The noise was replayed so as to reproduce the sound pressure levels measured in the helicopter during hover. Both noise spectrum and level were confirmed by one-third octaveband analysis. For active control, the helicopter noise was band-limited to from 10 to 1000 Hz. When tested on five subjects, the apparatus controlled the noise at the ear within this frequency range, and the control system was stable. The noise reduction recorded at the error microphone, i.e., close to the ear canal entrance, was in excess of 10 dB from 16 to 300 Hz for all subjects, and ranged from 10 to 26 dB at the rotor blade passage frequency (16 Hz), and from 10 to 20 dB at frequencies up to 200 Hz, depending on the subject. The differences in ANR experienced by the subjects are believed to be associated with variations in the fit of the headset, and remain the subject of continuing research.
Author
Feedforward Control; Digital Systems; Active Control; Noise Reduction; Aircraft Noise; Earphones; Flight Crews; Microphones; Real Time Operation; Signal Analyzers; Human Factors Engineering; Design Analysis

19970026406 Rigshospitalet, Dept. of Otolaryngology, Copenhagen, Denmark
Aircraft Noise Profiles and the Efficiency of Noise Protection Devices in the Royal Danish Air Force
Vesterhauge, S., Rigshospitalet, Denmark; Osterhammel, P. A., Rigshospitalet, Denmark; Rasmussen, A. Norby, Rigshospitalet, Denmark; Oldenburg, J. N. S., Royal Danish Air Force, Denmark; Jensen, E. S., Royal Danish Air Force, Denmark; Jun. 1997;

6p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Except for being hazardous to the function of the ear itself, noise has a lot of unpleasant non-organic capabilities. It is annoying, noise interferes with performance and efficiency, and it interferes with communication. No matter what we do, we all have to live with and accept certain levels of noise. This, indeed, counts for aviation too. It has been told, that when Louis Bleriot in 1909 flew from France to England, the noise from his 25 HP engine heard from the ground by those fortunate enough to witness this historic event, was probably 20 to 30 dB louder than the noise reaching the ground from a current jet aircraft. This was caused by the fact that Bleriot flew very much lower than modern aircraft. So, due to simple physical laws, the closer you are to a noise source. the more you are exposed. and those closest to an aircraft are those working in it or outside the plane. In the air force and in other flying units of our defense, personnel is exposed to high levels of noise. The purpose of the present study, is simply to map, in a comparable way the noise impact on personnel working at different positions in relation to aircraft used by the Danish defense - to establish the efficiency of different noise protection devices used by personnel working at different positions - and finally to advice the proper authorities concerning the proper use of noise protection devices in order to avoid as much as possible the harmful effects of aircraft noise as described above.

Author

Aircraft Noise; Ear Protectors; Noise Reduction; Human Factors Engineering; Auditory Fatigue; Occupational Diseases

19970026658 Civil Aeromedical Inst., Oklahoma City, OK USA

Effects of Mild Hypoxia on Pilot Performances 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; 43p; In English

Report No.(s): AD-A324719; 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.

DTIC

Hypoxia; Physiological Responses; General Aviation Aircraft; Pilot Performance; Flight Simulation; Altitude

19970026747 Illinois Univ., The Graduate College, Urbana-Champaign, IL USA

Displays for Spatial Situation Awareness: The Use of Spatial Enhancements to Improve Global and Local Awareness

Davenport, Clark E., Illinois Univ., USA; May 1997; 91p; In English

Report No.(s): AD-A325599; AFIT-97-050; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

In order to study the effect of display configuration on the spatial awareness facet of Situation Awareness (SA), we modified three displays with visual spatial enhancements to study their effects on local awareness and guidance and on global spatial awareness. A 2D coplanar display, a 3D exocentric display, and a 3D immersed/2D plan view display were modified using object display enhancements and visual momentum techniques. Pilots flew each display in a simulated low level tactical environment. Pilots' tasks were to navigate by the most direct route possible between waypoints positioned in 3D space and avoid stationary air and ground hazards (local awareness and guidance tasks). Additionally, they had to detect and verbally locate the position of intruder aircraft relative to ownship (clock position, relative altitude, and distance) that appeared on the screen. They also judged if and where the intruder would cross ownship's flight path (front, behind, not crossing) and the intruder's altitude change (climbing, level, or descending) (the global spatial awareness tasks). Results showed the spatial enhancements were effective in increasing local and global spatial situation awareness but did not eliminate all of the costs associated with each display format. The discussion explores the benefits and remaining costs of each display format in the context spatial situation awareness.

DTIC

Display Devices; Spatial Marching; Knowledge; Psychomotor Performance; Flight Simulation; Psychological Effects; Spatial Distribution

19970027242 Army Aeromedical Research Lab., Fort Rucker, AL USA

Proceedings of the First Triservice Conference on Rotary-Wing Spatial Disorientation: Spatial Disorientation in the Operational Rotary-Wing Environment *Final Report*

Braithwaite, Malcolm G., Army Aeromedical Research Lab., USA; DeRoche, Shannon L., Army Aeromedical Research Lab., USA; Alvarez, Eduardo A., Army Aeromedical Research Lab., USA; Reese, Melisa A., Army Aeromedical Research Lab., USA; Apr. 1997; 142p; In English, 24-26 Sep. 1996, Fort Rucker, AL, USA; Sponsored by Army Medical Research and Materiel Command, USA

Contract(s)/Grant(s): DA Proj. 3M1-62787-A-879

Report No.(s): AD-A324991; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Several recent studies at the U.S. Army Aeromedical Research Laboratory (USAARL) and the U.S. Army Safety Center (USASC) have highlighted the significant contribution of Spatial Disorientation (SD) to helicopter accidents. In the U.S. Army the cost can be approximated at $58M and 14 lives each year. Following some local training initiatives by USAARL and the U.S. Army School of Aviation Medicine (USASAM), the first Triservice Symposium on Spatial Disorientation in Rotary-Wing Operations was held from 24 September 1996 through 26 September 1996 at USASAM. This symposium sought to address three main areas: (1) the seriousness of the SD hazard; (2) current methods to control the hazard; and (3) the associated safety and risk management concerns. This report contains the proceedings of the symposium. The symposium was considered to be a success in raising the awareness of the impact of SD on rotary-wing flying operations in the aeromedical and safety communities of the services. It was clear that SD imposes a particular hazard to rotary wing operations which differs in many respects to that experienced by fixed wing operators. There was unanimous agreement that initiatives to overcome the problem must be made. In order to maintain the impetus established by the symposium and secure funding for the various initiatives, the report contains a memorandum detailing the important factors and makes recommendations for future activity in the area. Work is required in education, training, research, and equipment procurement. Control factors are discussed and recommendations made according to whether the approach should be solely directed towards the U.S. Army, or on a triservice basis.

DTIC

Disorientation; Aircraft Safety; Helicopters; Conferences; Aerospace Medicine; Physiological Factors

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.

19970026362 Old Dominion Univ., Dept. of Aerospace Engineering, Norfolk, VA USA

Gradient-Based Aerodynamic Shape Optimization Using ADI Method for Large-Scale Problems

Pandya, Mohagna J., Old Dominion Univ., USA; Baysal, Oktay, Old Dominion Univ., USA; Efficient Gradient-Based Shape Optimization Methodology Using Inviscid/Viscous CFD; May 1997; 12p; In English, USA; Also announced as 19970026360

Contract(s)/Grant(s): NCC1-211

Report No.(s): AIAA Paper 96-0091; C-8728; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A gradient-based shape optimization methodology, that is intended for practical three-dimensional aerodynamic applications, has been developed. It is based on the quasi-analytical sensitivities. The flow analysis is rendered by a fully implicit, finite volume formulation of the Euler equations.The aerodynamic sensitivity equation is solved using the alternating-direction-implicit (ADI) algorithm for memory efficiency. A flexible wing geometry model, that is based on surface parameterization and platform schedules, is utilized. The present methodology and its components have been tested via several comparisons. Initially, the flow analysis for for a wing is compared with those obtained using an unfactored, preconditioned conjugate gradient approach (PCG), and an extensively validated CFD code. Then, the sensitivities computed with the present method have been compared with those obtained using the finite-difference and the PCG approaches. Effects of grid refinement and convergence tolerance on the analysis and shape optimization have been explored. Finally the new procedure has been demonstrated in the design of a cranked arrow wing at Mach 2.4. Despite the expected increase in the computational time, the results indicate that shape optimization, which require large numbers of grid points can be resolved with a gradient-based approach.

Author

Shapes; Gradients; Optimization; Conjugate Gradient Method; Alternating Direction Implicit Methods; Aerodynamic Configurations; Finite Difference Theory; Computational Fluid Dynamics; Computational Grids

19970026364 Old Dominion Univ., Dept. of Aerospace Engineering, Norfolk, VA USA

Three-Dimensional Viscous Alternating Direction Implicit Algorithm and Strategies for Shape Optimization

Pandya, Mohagna J., Old Dominion Univ., USA; Baysal, Oktay, Old Dominion Univ., USA; May 1997; 11p; In English; 13th; Computational Fluid Dynamics, 29 Jun. - 2 Jul. 1997, Snowmass, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Also announced as 19970026360

Contract(s)/Grant(s): NCC1-211

Report No.(s): AIAA Paper 97-1853; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

A gradient-based shape optimization based on quasi-analytical sensitivities has been extended for practical three-dimensional aerodynamic applications. The flow analysis has been rendered by a fully implicit, finite-volume formulation of the Euler and Thin-Layer Navier-Stokes (TLNS) equations. Initially, the viscous laminar flow analysis for a wing has been compared with an independent computational fluid dynamics (CFD) code which has been extensively validated. The new procedure has been demonstrated in the design of a cranked arrow wing at Mach 2.4 with coarse- and fine-grid based computations performed with Euler and TLNS equations. The influence of the initial constraints on the geometry and aerodynamics of the optimized shape has been explored. Various final shapes generated for an identical initial problem formulation but with different optimization path options (coarse or fine grid, Euler or TLNS), have been aerodynamically evaluated via a common fine-grid TLNS-based analysis. The initial constraint conditions show significant bearing on the optimization results. Also, the results demonstrate that to produce an aerodynamically efficient design, it is imperative to include the viscous physics in the optimization procedure with the proper resolution. Based upon the present results, to better utilize the scarce computational resources, it is recommended that, a number of viscous coarse grid cases using either a preconditioned bi-conjugate gradient (PbCG) or an alternating-direction-implicit (ADI) method, should initially be employed to improve the optimization problem definition, the design space and initial shape. Optimized shapes should subsequently be analyzed using a high fidelity (viscous with fine-grid resolution) flow analysis to evaluate their true performance potential. Finally, a viscous fine-grid-based shape optimization should be conducted, using an ADI method, to accurately obtain the final optimized shape.

Author

Alternating Direction Implicit Methods; Shapes; Optimization; Aerodynamic Characteristics; Computational Fluid Dynamics; Computational Grids; Conjugate Gradient Method; Finite Volume Method; Navier-Stokes Equation; Viscous Flow; Laminar Flow; Gradients; Arrow Wings

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.

19970026382 Armstrong Lab., Bioacoustics and Biocommunications Branch, Wright-Patterson AFB, OH USA

Audio Display Technology

McKinley, Richard L., Armstrong Lab., USA; Jun. 1997; 8p; In English; Also announced as 19970026380; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The scientific community has experienced substantial growth in knowledge and in the understanding of human auditory localization, particularly in recent decades. This background has spawned the concept of 3-dimensional (3-D) sound and has demonstrated that audio cues can be created and presented over headphones that indicate the location of sounds around the listener. This concept has been incorporated in prototype and commercial systems that synthetically create this virtual or 3-dimensional audio display. Spatial auditory information via 3-D audio displays, has demonstrated significant enhancements in target detection and acquisition, threat avoidance, voice communications enhancement, and situational awareness in laboratory investigations, simulators, and flight demonstrations. Numerous applications in both military and civilian arenas have been identified, and many demonstrated. Although significant enhancements have been obtained, ongoing work is required in the areas of display resolution, head related transfer functions with an emphasis on elevation cues, spatial auditory symbology, distance cues, and sensory interactions involving audio/visual and audio/visual/vestibular systems. Research and development will continue to enhance the understanding and performance of 3-D audio displays. Applications of this spatial auditory information technology will continue to expand in all areas providing even greater increases in user performance and safety.

Author

Voice Communication; Display Devices; Human Factors Engineering; Cockpits; Earphones; Sound Transmission; Auditory Perception

19970026585 Office National d'Etudes et de Recherches Aerospatiales, Paris, France

Aeroacoustics of Open Rotors, Part 1, Discrete Frequency Rotor Noise ***Aeroacoustique Des Rotors Non Carenes, Partie 1, Methode de prevision du bruit de raies des rotors***

Prieur, Jean, Office National d'Etudes et de Recherches Aerospatiales, France; Mar. 1997; ISSN 0078-3780; 122p; In French; Applied Aero-Acoustics: Prediction Methods, 26 Feb. - 1 Mar. 1996, Rhode Saint Genese, Belgium

Report No.(s): ONERA-1997-1; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This paper presents and discusses from a physical point of view the Ffowcs Williams-Hawkings equations which serves as a basis for any integral formulation of the acoustic field of moving bodies. Several integration methods in the time and frequency domains are presented and analyzed. Application to the prediction of transonic rotor noise is explained and singularity problems encountered in supersonic rotor noise calculations are addressed. Finally the Kirchhoff formulation is presented as a complementary approach and, in some cases, an alternative to the integration of Ffowcs-Hawkings equation. This document addresses from a physical and computational point of view the impulsive noise generated by helicopter main rotors at low speed (Blade-Vortex Interaction noise) and high speed (High-Speed Impulsive noise). The mechanisms of noise generation are presented and governing parameters pointed out. Emphasis is put on the physics and on the resulting implications in terms of modeling and computational accuracy at each step of the prediction methods. A state of the art of the method is presented along with typical results.
Author

Rotor Aerodynamics; Blade-Vortex Interaction; Aerodynamic Noise; High Speed; Noise Generators; Aeroacoustics

18
SPACE SCIENCES

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

19970026367 Fluid Gravity Engineering Ltd., Liphook, UK

Planetary Atmospheres, Basic Thermodynamics and Regimes

Smith, Arthur, Fluid Gravity Engineering Ltd., UK; May 1995; 22p; In English; Also announced as 19970026365; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In Sessions 2 to 4 we shall revue some of the basic phenomena relevant to capsule aerothermodynamics prior to the more detailed Sessions later in the course. Much of the material in these first Sessions is undergraduate material and refers to simple methods in order to introduce the student to the subject with the emphasis on understanding the phenomena rather than a briefing on state of the art techniques. However understanding aerothermodynamics requires understanding of basic mathematics, physics and chemistry which is assumed for this course. A short list of references is given to each section which has deliberately been kept small such that the student should aim to read all of these in detail. Some of the classic works have been included which although early give good detailed explanations of the subject phenomena. Session 2 Begins with the atmosphere structure followed by some basic thermodynamics used in aerothermodynamics, and ends with a revue of the classical aerodynamic and aerothermal regimes encountered by a capsule during entry.
Author

Aerothermodynamics; Planetary Atmospheres; Aerodynamic Heating; Hypersonic Reentry; Spacecraft Reentry; Hypersonic Flow; Rarefied Gas Dynamics

19970026945 NASA Langley Research Center, Hampton, VA USA

Mars Pathfinder Atmospheric Entry Navigation Operations

Braun, R. D., NASA Langley Research Center, USA; Spencer, D. A., Jet Propulsion Lab., California Inst. of Tech., USA; Kallemeyn, P. H., Jet Propulsion Lab., California Inst. of Tech., USA; Vaughan, R. M., Jet Propulsion Lab., California Inst. of Tech., USA; 1997; 14p; In English; GNC, AFM, and MST Conference and Exhibit, 11-13 Aug. 1997, New Orleans, LA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): NASA-TM-112885; AIAA Paper 97-3663; NAS 1.15:112885; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

On July 4, 1997, after traveling close to 500 million km, the Pathfinder spacecraft successfully completed entry, descent, and landing, coming to rest on the surface of Mars just 27 km from its target point. In the present paper, the atmospheric entry and approach navigation activities required in support of this mission are discussed. In particular, the flight software parameter update and landing site prediction analyses performed by the Pathfinder operations navigation team are described. A suite of simulation tools developed during Pathfinder's design cycle, but extendible to Pathfinder operations, are also presented. Data regarding the accuracy of the primary parachute deployment algorithm is extracted from the Pathfinder flight data, demonstrating that this algo-

rithm performed as predicted. The increased probability of mission success through the software parameter update process is discussed. This paper also demonstrates the importance of modeling atmospheric flight uncertainties in the estimation of an accurate landing site. With these atmospheric effects included, the final landed ellipse prediction differs from the post-flight determined landing site by less then 0.5 km in downtrack.
Author
Mars Pathfinder; Mars Surface; Navigation; Deployment; Descent; Flight Control; Landing Sites

19970026977 NASA Langley Research Center, Hampton, VA USA
Entry Dispersion Analysis for the Stardust Comet Sample Return Capsule
Desai, Prasun N., NASA Langley Research Center, USA; Mitcheltree, Robert A., NASA Langley Research Center, USA; Cheatwood, F. McNeil, NASA Langley Research Center, USA; 1997; 12p; In English; GNC, AFM, and MST, 11-13 Aug. 1997, New Orleans, LA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA-TM-112884; AIAA-97-3812; NAS 1.15:112884; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Stardust will be the first mission to return samples from beyond the Earth-Moon system. The sample return capsule, which is passively controlled during the fastest Earth entry ever, will land by parachute in Utah. The present study analyzes the entry, descent, and landing of the returning sample capsule. The effects of two aerodynamic instabilities are revealed (one in the high altitude free molecular regime and the other in the transonic/subsonic flow regime). These instabilities could lead to unacceptably large excursions in the angle-of-attack near peak heating and main parachute deployment, respectively. To reduce the excursions resulting from the high altitude instability, the entry spin rate of the capsule is increased. to stabilize the excursions from the transonic/subsonic instability, a drogue chute with deployment triggered by an accelerometer and timer is added prior to main parachute deployment. A Monte Carlo dispersion analysis of the modified entry (from which the impact of off-nominal conditions during the entry is ascertained) shows that the capsule attitude excursions near peak heating and drogue chute deployment are within Stardust program limits. Additionally, the size of the resulting 3-sigma landing ellipse is 83.5 km in downrange by 29.2 km in crossrange, which is within the Utah Test and Training Range boundaries.
Author
Comets; Earth-Moon System; Monte Carlo Method; Subsonic Flow; High Altitude; Downrange; Attitude (Inclination); Atmospheric Entry; Angle of Attack; Descent

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