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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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

Key

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2. Title
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7. Abstract
8. Abstract Author
9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 344)

MARCH 21, 1997

02
AERODYNAMICS

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

19970009491 NASA Lewis Research Center, Cleveland, OH USA

Tests of the Performance of Coatings for Low Ice Adhesion

Anderson, David N., NASA Lewis Research Center, USA; Reich, Allen D., Goodrich (B. F.) Co., USA; Jan. 1997; 14p; In English; 35th; Aerospace Sciences Meeting and Exhibit, 6-10 Jan. 1997, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 548-20-23

Report No.(s): NASA-TM-107399; E-10604; NAS 1.15:107399; AIAA Paper 97-0303; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper reports studies of the performance of low-ice-adhesion coatings by NASA Lewis and BFGoodrich. Studies used impact ice accreted both in the NASA Lewis Icing Research Tunnel (IRT) and in the BFGoodrich Icing Wind Tunnel (IWT) and static ice in a BFGoodrich bench-top parallel-plate shear rig. Early tests at NASA Lewis involved simple qualitative evaluations of the ease of removing impact ice from a surface. Coated surfaces were compared with uncoated ones. Some of the coatings were tested again with static ice at BFGoodrich to obtain quantitative measurements. Later, methods to establish the adhesion force on surfaces subjected to impact ice were explored at Lewis. This paper describes the various test programs and the results of testing some of the coatings looked at over the past 5 years. None of the coatings were found to be truly ice-phobic; however, the most effective coatings were found to reduce the adhesion of ice to about 1/2 that of an uncoated aluminum sample.

Author

Ice Formation; Performance Tests; Adhesion; Coatings; Metal Surfaces; Aircraft Icing; Aircraft Safety

19970009633 NASA Lewis Research Center, Cleveland, OH USA

Characterization of Ice Roughness From Simulated Icing Encounters

Anderson, David N., NASA Lewis Research Center, USA; Shin, Jaiwon, NASA Lewis Research Center, USA; Jan. 1997; 16p; In English; 35th; Aerospace Sciences Meeting and Exhibit, 6-10 Jan. 1997, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 548-20-23

Report No.(s): NASA-TM-107400; NAS 1.15:107400; AIAA Paper 97-0052; E-10606; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Detailed measurements of the size of roughness elements on ice accreted on models in the NASA Lewis Icing Research Tunnel (IRT) were made in a previous study. Only limited data from that study have been published, but included were the roughness element height, diameter and spacing. In the present study, the height and spacing data were found to correlate with the element diameter, and the diameter was found to be a function primarily of the non-dimensional parameters freezing fraction and accumulation parameter. The width of the smooth zone which forms at the leading edge of the model was found to decrease with increasing accumulation parameter. Although preliminary, the success of these correlations suggests that it may be possible to develop simple relationships between ice roughness and icing conditions for use in ice-accretion-prediction codes. These codes now require an ice-roughness estimate to determine convective heat transfer. Studies using a 7.6-cm-diameter cylinder and a 53.3-cm-chord NACA 0012 airfoil were also performed in which a 1/2-min icing spray at an initial set of conditions was followed by a 9-1/2-min spray at a second set of conditions. The resulting ice shape was compared with that from a full 10-min spray at

the second set of conditions. The initial ice accumulation appeared to have no effect on the final ice shape. From this result, it would appear the accreting ice is affected very little by the initial roughness or shape features.
Author
Ice Formation; Aircraft Icing; Surface Roughness; Size (Dimensions); Simulation

19970009817 NASA Dryden Flight Research Center, Edwards, CA USA
The F/A-18 High-Angle-of-Attack Ground-to-Flight Correlation; Lessons Learned
Banks, Daniel W., NASA Dryden Flight Research Center, USA; Fisher, David F., NASA Dryden Flight Research Center, USA; Hall, Robert M., NASA Langley Research Center, USA; Erickson, Gary E., NASA Langley Research Center, USA; Murri, Daniel G., NASA Langley Research Center, USA; Grafton, Sue B., NASA Langley Research Center, USA; Sewall, William G., NASA Langley Research Center, USA; Jan. 1997; 44p; In English; NASA Langely High-Angle-of-Attack Technology Conference, 17-19 Sep. 1996, Hampton, VA, USA; Sponsored by NASA Langley Research Center, USA
Contract(s)/Grant(s): RTOP 505-68-30
Report No.(s): NASA-TM-4783; NAS 1.15:4783; H-2149; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Detailed wind tunnel and flight investigations were performed on the F/A-18 configuration to explore the causes of many high-angle-of-attack phenomena and resulting disparities between wind tunnel and flight results at these conditions. Obtaining accurate predictions of full-scale flight aerodynamics from wind-tunnel tests is important and becomes a challenge at high-angle-of-attack conditions where large areas of vortical flow interact. The F/A-18 airplane was one of the first high-performance aircraft to have an unrestricted angle-of-attack envelope, and as such the configuration displayed many unanticipated characteristics. Results indicate that fixing forebody crossflow transition on models can result in a more accurate match of flow fields, and thus a more accurate prediction of aerodynamic characteristics of flight at high angles of attack. The wind tunnel results show that small geometry differences, specifically nosebooms and aft-end distortion, can have a pronounced effect at high angles of attack and must be modeled in sub-scale tests in order to obtain accurate correlations with flight.
Author
Angle of Attack; Wind Tunnel Tests; Flight Tests; Aircraft Performance; Flow Distribution; Aerodynamic Characteristics; Fighter Aircraft

19970009827 NASA Lewis Research Center, Cleveland, OH USA
A Computational-Experimental Development of Vortex Generator Use for a Transitioning S-Diffuser
Wendt, Bruce J., Modern Technologies Corp., USA; Dudek, Julianne C., NASA Lewis Research Center, USA; Nov. 1996; 10p; In English; International Mechanical Engineering Conference and Exhibit, 17-22 Nov. 1996, Atlanta, GA, USA; Sponsored by American Society of Mechanical Engineers, USA
Contract(s)/Grant(s): NAS3-27333; RTOP 523-36-13
Report No.(s): NASA-TM-107357; NAS 1.15:107357; E-10511; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The development of an effective design strategy for surface-mounted vortex generator arrays in a subsonic diffuser is described in this report. This strategy uses the strengths of both computational and experimental analyses to determine beneficial vortex generator locations and sizes. A parabolized Navier-Stokes solver, RNS3D, was used to establish proper placement of the vortex generators for reduction in circumferential total pressure distortion. Experimental measurements were used to determine proper vortex generator sizing to minimize total pressure recovery losses associated with vortex generator device drag. The best result achieved a 59% reduction in the distortion index DC60, with a 0.3% reduction in total pressure recovery.
Author
Vortex Generators; Diffusers; Navier-Stokes Equation; Pressure Recovery

19970009829 NASA Langley Research Center, Hampton, VA USA
Active Control of Boundary-Layer Instabilities: Use of Sensors and Spectral Controller
Joslin, R. D., NASA Langley Research Center, USA; Nicolaides, R. A., Carnegie-Mellon Univ., USA; Erlebacher, G., Institute for Computer Applications in Science and Engineering, USA; Hussaini, M. Y., Institute for Computer Applications in Science and Engineering, USA; Gunzburger, M. D., Virginia Polytechnic Inst. and State Univ., USA; AIAA Journal; Jan. 31, 1995; Volume 33, No. 8, pp. 1521-1523; In English
Contract(s)/Grant(s): NAS1-10801
Report No.(s): NASA-CR-203336; NAS 1.26:203336; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Full Navier-Stokes equations were conducted to determine the feasibility of automating the control of wave instabilities within a flat plate boundary layer with sensors, actuators, and a spectral controller. The results indicate that a measure of wave cancella-

tion can be obtained for small and large amplitude instabilities without feedback; however, feedback is required to optimize the control amplitude and phase for exact wave cancellation.
Derived from text
Active Control; Navier-Stokes Equation; Flat Plates; Actuators; Feedback Control; Boundary Layer Control; Boundary Layer Stability

19970009851 NYMA, Inc., Experimental Fluid Dynamics Div., Brook Park, OH USA
Aeroacoustic Characteristics of a Rectangular Multi-Element Supersonic Jet Mixer-Ejector Nozzle
Raman, Ganesh, NYMA, Inc., USA; Taghavi, Ray, Kansas Univ., USA; Dec. 1996; 42p; In English; Fluids Engineering Division Summer Meeting, 13-18 Aug. 1995, Hilton Head, SC, USA; Sponsored by American Society of Mechanical Engineers, USA
Contract(s)/Grant(s): NAS3-27186; RTOP 537-02-22
Report No.(s): NASA-CR-195460; NAS 1.26:195460; E-9587; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper provides a unique, detailed evaluation of the acoustics and aerodynamics of a rectangular multi-element supersonic jet mixer-ejector noise suppressor. The performance of such mixer-ejectors is important in aircraft engine application for noise suppression and thrust augmentation. In contrast to most prior experimental studies on ejectors that reported either aerodynamic or acoustic data, our work documents both types of data. We present information on the mixing, pumping, ejector wall pressure distribution, thrust augmentation and noise suppression characteristics of four simple, multi-element, jet mixer-ejector configurations. The four configurations included the effect of ejector area ratio (AR = ejector area/primary jet area) and the effect of non-parallel ejector walls. We also studied in detail the configuration that produced the best noise suppression characteristics. Our results show that ejector configurations that produced the maximum maximum pumping (entrained flow per secondary inlet area) also exhibited the lowest wall pressures in the inlet region, and the maximum thrust augmentation. When cases having the same total mass flow were compared, we found that noise suppression trends corresponded with those for pumping. Surprisingly, the mixing (quantified by the peak Mach number, and flow uniformity) at the ejector exit exhibited no relationship to the noise suppression at moderate primary jet fully expanded Mach numbers (Mj is less than 1.4). However, the noise suppression dependence on the mixing was apparent at higher Mj. The above observations are justified by noting that the mixing at the ejector exit is ot a strong factor in determining the radiated noise when noise produced internal to the ejector dominates the noise field outside the ejector.
Author
Acoustic Properties; Aerodynamic Characteristics; Aircraft Engines; Engine Noise; Jet Aircraft Noise; Pressure Distribution; Thrust Augmentation; Nozzle Geometry

19970009931 NASA Lewis Research Center, Cleveland, OH USA
Experimental Investigation of Crossing Shock Wave-Turbulent Boundary Layer-Bleed Interaction
Kim, Hyun, NASA Lewis Research Center, USA; Hingst, Warren R., NASA Lewis Research Center, USA; Davis, David O., NASA Lewis Research Center, USA; Dec. 1996; 12p; In English; 35th; Aerospace Sciences Meeting and Exhibit, 6-10 Jan. 1997, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 505-62-52
Report No.(s): NASA-TM-107392; NAS 1.15:107392; AIAA Paper 97-0608; E-10592; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Results of an experimental investigation of a symmetric crossing shock wave/turbulent boundary layer/bleed interaction are presented for a freestream unit Reynolds number of 1.68 x 10(exp 7)/m, a Mach number of 2.81, and deflection angles of 8 degrees. The data obtained in this study are bleed mass flow rate using a trace gas technique, qualitative information in the form of oil flow visualization, flow field Pitot pressures, and static pressure measurements using pressure sensitive paint. The main objective of this test is two-fold. First, this study is conducted to explore boundary layer control through mass flow removal near a large region of separated flow caused by the interaction of a double fin-induced shock wave and an incoming turbulent boundary layer. Also, a comprehensive data set is needed for computational fluid dynamics code validation.
Author
Boundary Layer Control; Pressure Measurement; Flow Visualization; Turbulent Boundary Layer; Mass Flow Rate; Static Pressure; Shock Waves

19970010155 Saint Louis Univ., Park College; Aerospace and Mechanical Engineering, MO USA
Further Study of 'Pop-Up' Vortex Generators ***Final Report***
Manor, David, Saint Louis Univ., USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The model is a replica of a modified MAX-103 kit aircraft that our Parks College of St. Louis University Student Design Group built and modified from a tail wheel to a tricycle configuration. A model was tested in the Parks College low-speed wind tunnel. I hope to initiate flight-testing upon my second return to. St. Louis. The combined data using wind tunnel, water tunnel, RC, flight-testing and analytical results will be very valuable for assessing the correlation between the different methods of analyses, since at present it is almost impossible to accurately predict flight characteristics from anything but in-situ tests. Unfortunately, political/financial reasons dictated using a generic wing rather than a specific model in the NASA-DFRC water tunnel.
Derived from text
Angle of Attack; Flight Characteristics; Flight Tests; Vortex Generators

19970010174 Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA
Supersonic Channel Concept for Enhancement of Lift/Drag Ratio ***Final Report***
Ruffin, Stephen M., Georgia Inst. of Tech., USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The concept studied during the summer NASA/ASEE Fellowship provides a means of lowering drag and a means for directional control of supersonic and hypersonic vehicles. Low drag and efficient directional control are essential for the success of aircraft, atmospheric entry vehicles, missiles, and other vehicles in supersonic and hypersonic flight. Drag reduction can result in increased vehicle range, increased speed, improved fuel efficiency, increased lift/drag ratio, and increased climb rate. For high supersonic and hypersonic vehicles heat transfer considerations dictate the design of the nose and leading edge. The heat transfer to such vehicles is most severe at stagnation points which occur on the leading edges and nose of the vehicle. Theoretical formulations, experimental data, and semi-empirical formulas all agree in the fact that stagnation point heat transfer is inversely proportional to the square root of the nose or leading edge radius. Thus, the noses and leading edges of supersonic and hypersonic vehicles are typically blunted so that the heat transfer and structural loads will be manageable. However, much of the wave drag experienced by these vehicles is due to nose blunting.
Derived from text
Drag Reduction; Supersonic Flight; Lift Drag Ratio; Aerodynamic Heat Transfer

19970010254 Modern Technologies Corp., Middleburg Heights, OH USA
Spanwise Spacing Effects on the Initial Structure and Decay of Axial Vortices ***Final Report***
Wendt, B. J., Modern Technologies Corp., USA; Reichert, B. A., Kansas State Univ., USA; Nov. 1996; 14p; In English
Contract(s)/Grant(s): NAS3-27377; RTOP 523-36-13
Report No.(s): NASA-CR-198544; NAS 1.26:198544; E-10512; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The initial structure and axial decay of an array of streamwise vortices embedded in a turbulent pipe boundary layer is experimentally investigated. The vortices are shed in counter-rotating fashion from an array of equally-spaced symmetric airfoil vortex generators. Vortex structure is quantified in terms of crossplane circulation and peak streamwise vorticity. Flow conditions are subsonic and incompressible. The focus of this study is on the effect of the initial spacing between the parent vortex generators. Arrays with vortex generators spaced at 15 and 30 degrees apart are considered. When the spacing between vortex generators is decreased the circulation and peak vorticity of the shed vortices increases. Analysis indicates this strengthening results from regions of fluid acceleration in the vicinity of the vortex generator array. Decreased spacing between the constituent vortices also produces increased rates of circulation and peak vorticity decay.
Author
Wing Span; Airfoils; Vortex Generators; Turbulent Boundary Layer; Three Dimensional Boundary Layer

19970010275 Brown Univ., Div. of Applied Mathematics, Providence, RI USA
High Order Accuracy Computational Methods in Aerodynamics Using Parallel Architectures ***Final Report, 15 Jan. 1995 - 31 Mar. 1996***
Gottlieb, David, Brown Univ., USA; Shu, C. W., Brown Univ., USA; Fischer, P. F., Brown Univ., USA; Don, W. S., Brown Univ., USA; Aug. 02, 1996; 6p; In English
Contract(s)/Grant(s): F49620-95-1-0074
Report No.(s): AD-A313224; AFOSR-TR-96-0433; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The main theme of this research is the application of high order accurate schemes to complicated flow problems. The advantage of using high order schemes for long time simulations is widely recognized by now. Also for problems where fine details

of the flow field have to be captured accurately the use of high accuracy schemes is mandatory. These two classes of problems encompass many of the current problems in scientific computing.
DTIC
Computational Fluid Dynamics; Computerized Simulation

19970010324 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Flutter Analysis and Analytic Sensitivities for Trapezoidal Panels
Mineau, David, Washington Univ., USA; Jan. 1996; 96p; In English
Report No.(s): AD-A309222; AFIT-96-004; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Explicit expressions for the stiffness, geometric stiffness, mass, and aerodynamic force matrices are derived for the flutter analysis of simply supported composite wing panels. The formulation is based on Ritz analysis using simple polynomials and Piston Theory aerodynamics. The use of simple polynomials eliminates the need for numerical quadrature and decreases computation time. Analytic sensitivities of the aeroelastic system matrices and critical dynamic pressures are obtained with respect to layer thickness, fiber direction, and panel shape. The method is integrated with wing box analysis based on either the equivalent plate approach or finite element method, making it possible to obtain sensitivities of the stability boundary with respect to wing planform shape or locations of ribs and spars. The analytic sensitivities are used to construct approximations of the aeroelastic stability boundary for integrated wing/panel design synthesis, finite element method, making it possible to obtain sensitivities of the stability boundary with respect to wing planform shape or locations of ribs and spars. The analytic sensitivities are used to construct approximations of the aeroelastic stability boundary for integrated wing/panel design synthesis.
DTIC
Flutter Analysis; Aeroelasticity; Wing Panels; Composite Structures; Dynamic Pressure; Finite Element Method; Stress-Strain Relationships; Aerodynamic Loads

19970010329 Illinois Inst. of Tech., Fluid Dynamic Research Center, Chicago, IL USA
Investigation of the Physics of Screech in Supersonic Jets and Turbulent Boundary Layers at High Reynolds Number and Control of Separation Through Oscillatory Blowing ***Final Report, 1 Mar. 1993 - 1 Mar 1996***
Nagib, Hassan, Illinois Inst. of Tech., USA; Wark, Candace, Illinois Inst. of Tech., USA; Naguib, Ahmed, Illinois Inst. of Tech., USA; Wygnanski, Israel, Illinois Inst. of Tech., USA; Hites, Michael, Illinois Inst. of Tech., USA; Mar. 15, 1996; 79p; In English
Contract(s)/Grant(s): F49620-93-1-0154
Report No.(s): AD-A309863; AFOSR-TR-96-0272; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Using a flapped NACA 0015 airfoil, measurements of static pressure and lift, with and without oscillatory forcing from the leading edge and flap, demonstrated effective separation control and lift enhancement over the range 0.1 less than M less than 0.4. Measurements showed that the lift increment was sensitive to the dimensionless forcing frequency. Additionally, a suction pressure coefficient of nearly -5.0 was produced on a previously stalled airfoil at M=0.4, indicating a region of supercritical flow on the airfoil, and suggesting that oscillatory blowing is a viable separation-control technique under compressible flow conditions. Using both the NDF test-section floor boundary layer and a suspended axisymmetric body, a range of momentum thickness Reynolds numbers of 7000 less than Re less than 50000 was investigated with a hot-wire anemometer. Streamwise mean and rms velocity and spectra in these boundary layers showed good agreement with established scaling observations. An increasing separation of scales and the appearance of a second low-frequency spectral peak were observed indicating a clear discrimination between inner and outer scales at high Reynolds number. Although some dependence on both axial and momentum thickness Reynolds number was observed, there appeared to be a linear relationship between friction velocity and free-stream velocity over this wide range of Reynolds numbers.
DTIC
Turbulent Boundary Layer; Supersonic Jet Flow; High Reynolds Number; Oscillations; Blowing

19970010343 Naval Postgraduate School, Monterey, CA USA
Evaluation of the Boeing Pan Air Technologies Code (A502i) Through Prediction of Separation Forces on the GBU-24
LeTourneau, Matthew A., Naval Postgraduate School, USA; Mar. 1996; 116p; In English; Original contains color plates
Report No.(s): AD-A311017; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Boeing PAN AIR Technologies code (A502i) is investigated to explore its suitability for determination of separation forces on ordnance. to this end, A502i is first assessed by applying it to three problems for which other solutions and experimental data are available, i.e. steady flow past a rectangular, parabolic arc wing and a delta wing at both subsonic and supersonic condi-

tions. Good agreement is found in all cases. A502i is then applied to the GBU-24's being in two configurations for a subsonic case and a supersonic case. Good agreement is found with data obtained from wind tunnel experiments for low angles of attack.
DTIC
Aerodynamic Forces; Ordnance; Angle of Attack; Wind Tunnel Models; Trajectories

03
AIR TRANSPORTATION AND SAFETY

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

19970009401 NASA Langley Research Center, Hampton, VA USA
Overview of Structural Behavior and Occupant Responses from Crash Test of a Composite Airplane
Jones, Lisa E., NASA Langley Research Center, USA; Carden, Huey D., NASA Langley Research Center, USA; Proceedings of the General, Corporate and Regional Aviation Meeting and Exposition; 1995; ISSN 0148-7191; 12p; In English; General, Corporate and Regional Aviation Meeting and Exposition, 3-5 May 1995, Wichita, KS, USA
Report No.(s): NASA-TM-111954; NAS 1.15:111954; SAE-TP-951168; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As part of NASA's composite structures crash dynamics research, a general aviation aircraft with composite wing, fuselage and empennage (but with metal subfloor structure) was crash tested at the NASA Langley Research Center Impact Research Facility. The test was conducted to determine composite aircraft structural behavior for crash loading conditions and to provide a baseline for a similar aircraft test with a modified subfloor. Structural integrity and cabin volume were maintained. Lumbar loads for dummy occupants in energy absorbing seats wer substantially lower than those in standard aircraft seats; however, loads in the standard seats were much higher that those recorded under similar conditions for an all-metallic aircraft.
Author
Aircraft Structures; Composite Structures; Crashes; Loads (Forces); Lumbar Region; Seats; Aircraft Safety; Research Facilities

19970010283 Federal Aviation Administration, Atlantic City, NJ USA
International Conference on Cabin Safety Research Conference Proceedings *Final Report*
Mar. 1996; 427p; In English; Cabin Safety Research, 14-16 Nov. 1995, Atlantic City, NJ, USA
Report No.(s): AD-A310777; AAR-422; DOT/FAA/AR-95-120; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

This publication contains the proceedings of the International Conference on Cabin Safety Research held in Atlantic City, New Jersey, November 14-16, 1995. Presentations were made and break out sessions were held in the following areas: evacuation, in- flight emergencies, crash dynamics and fire safety.
DTIC
Aeronautics; Safety; Fire Prevention; Crashes

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

19970009595 Federal Aviation Administration, Airport and Aircraft Safety, Atlantic City, NJ USA
Evaluation of Approach Path Indicator Systems for Heliports *Final Report*
Bagot, Keith, Federal Aviation Administration, USA; Apr. 1996; 237p; In English
Report No.(s): AD-A310288; DOT/FAA/AR-95/102; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The objective of this report was to determine the acceptability of using existing approach path indicator technology to develop the criteria for establishing production and installation requirements for approach path indicators for heliports. The approach path indicators give the pilot a visual reference as to his proximity to a specific approach angle to the heliport in visual flight rule (VFR) landing operations. This effort required photometric testing for actual light beam characteristics, the collection of ground tracking data, and flight testing for pilot feedback as to their acceptability of the systems. Results of the evaluation showed that all three existing approach path indicator systems provided the necessary guidance to the pilot to successfully conduct VFR landing operations, and that the data collected could be used to establish criteria for their production and installation.
DTIC
Approach Indicators; Heliports; Flight Tests; Visual Flight Rules; Data Acquisition; Ground Tests

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970009398 Georgia Inst. of Tech., Aerospace Systems Design Lab., Atlanta, GA USA
Effect of Mission Requirements on the Economic Robustness of an HSCT Concept
Mavris, Dimitri N., Georgia Inst. of Tech., USA; Bandte, Oliver, Georgia Inst. of Tech., USA; Schrage, Daniel P., Georgia Inst. of Tech., USA; 1996; 11p; In English; 18th; International Society of Parametric Analysts, Jun. 1996, Cannes, France; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Design for robustness and its subset design for economic robustness and viability are two areas in current design methodology and optimization research attracting a lot of attention. as the increasing number of publications and industry position papers in this field indicate. In fact. these publications attempt to address the paradigm shift taking place in industry! where design for performance is being replaced by design for affordability. That is designing and optimizing a system for a high yield while reducing the variation from that optimum yield. The study presented here can be viewed as a proof of concept for a proposed approach to design for robustness. called Robust Design Simulation (RDS). The paper outlines an alternative approach to Taguchi's, assigning probability distributions to uncontrollable factors (noise variables) which result in a distribution for the design objective instead of a point solution. The study also illustrates that indeed one is able to manipulate the mean and variance of the design objective concurrently, hence. optimizing a new Overall Evaluation Criterion (OEC) that is comprised of both the mean and variance of the design objective. The High Speed Civil Transport (HSCT) was utilized as an illustrative case to demonstrate the implementation of RDS. The objective of this case study is to show and quantify the effects of mission and aircraft sizing parameters on the mean and variance of direct and total operating cost as well as the required average yield per revenue passenger mile ($/RPM). Finally. the optimal mission requirement settings which yield an OEC that concurrently minimizes the mean $/RPM as well as its variance are identified for the HSCT configuration studied.
Author
Economic Factors; Economic Impact; Design to Cost; Design Analysis; Criteria; Aerospace Planes

19970009399 Georgia Inst. of Tech., Aerospace Systems Design Lab., Atlanta, GA USA
Application of Probabilistic Methods for the Determination of an Economically Robust HSCT Configuration
Mavris, Dimitri N., Georgia Inst. of Tech., USA; Bandte, Oliver, Georgia Inst. of Tech., USA; Schrage, Daniel P., Georgia Inst. of Tech., USA; 1996; 11p; In English; Multidisciplinary Analysis and Optimization Conference, Sep. 1996, Bellevue, WA, USA; Sponsored by NASA Washington, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper outlines an approach for the determination of economically viable robust design solutions using the High Speed Civil Transport (HSCT) as a case study. Furthermore, the paper states the advantages of a probability based aircraft design over the traditional point design approach. It also proposes a new methodology called Robust Design Simulation (RDS) which treats customer satisfaction as the ultimate design objective. RDS is based on a probabilistic approach to aerospace systems design, which views the chosen objective as a distribution function introduced by so called noise or uncertainty variables. Since the designer has no control over these variables, a variability distribution is defined for each one of them. The cumulative effect of all these distributions causes the overall variability of the objective function. For cases where the selected objective function depends heavily on these noise variables, it may be desirable to obtain a design solution that minimizes this dependence. The paper outlines a step by step approach on how to achieve such a solution for the HSCT case study and introduces an evaluation criterion which guarantees the highest customer satisfaction. This customer satisfaction is expressed by the probability of achieving objective function values less than a desired target value.
Author
Aircraft Design; Aerospace Planes; Supersonic Transports; Probability Theory; Design to Cost; Criteria

19970009400 Georgia Inst. of Tech., Aerospace Systems Design Lab., Atlanta, GA USA
System Synthesis in Preliminary Aircraft Design using Statistical Methods
DeLaurentis, Daniel, Georgia Inst. of Tech., USA; Mavris, Dimitri N., Georgia Inst. of Tech., USA; Schrage, Daniel P., Georgia Inst. of Tech., USA; 1996; 13p; In English; 20th; Congress of the International Council of the Aeronautical Sciences, 8-13 Sep. 1996, Sorrento, Italy
Contract(s)/Grant(s): NAGw-4337; NAG2-900
Report No.(s): NASA-CR-203326; NAS 1.26:203326; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper documents an approach to conceptual and preliminary aircraft design in which system synthesis is achieved using statistical methods, specifically design of experiments (DOE) and response surface methodology (RSM). These methods are

employed in order to more efficiently search the design space for optimum configurations. In particular, a methodology incorporating three uses of these techniques is presented. First, response surface equations are formed which represent aerodynamic analyses, in the form of regression polynomials, which are more sophisticated than generally available in early design stages. Next, a regression equation for an overall evaluation criterion is constructed for the purpose of constrained optimization at the system level. This optimization, though achieved in a innovative way, is still traditional in that it is a point design solution. The methodology put forward here remedies this by introducing uncertainty into the problem, resulting a solutions which are probabilistic in nature. DOE/RSM is used for the third time in this setting. The process is demonstrated through a detailed aero-propulsion optimization of a high speed civil transport. Fundamental goals of the methodology, then, are to introduce higher fidelity disciplinary analyses to the conceptual aircraft synthesis and provide a roadmap for transitioning from point solutions to probabalistic designs (and eventually robust ones).

Author

Experiment Design; Statistical Analysis; Aircraft Design; Multidisciplinary Design Optimization; Aerodynamic Configurations; Probability Theory; Propulsion System Configurations

19970009593 Dayton Univ. Research Inst., Structural Integrity Div., OH USA

Flight Loads Data for a Boeing 737-400 in Commercial Operation ***Final Report***

Skinn, D., Dayton Univ. Research Inst., USA; Miedlar, P., Dayton Univ. Research Inst., USA; Kelly, L., Dayton Univ. Research Inst., USA; Apr. 1996; 87p; In English

Report No.(s): AD-A310289; UDR/TR-95-62; DOT/FAA/AR-95/21; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report presents the flight data collected in 1993 from one Boeing 737-400 during routine commercial operation. The data collection program is part of a joint FAA/NASA effort to develop a flight recorder to obtain statistical loads data on commercial transport (FAR Part 25) aircraft during routine operations. During this prototype data collection program, 593 flights of operational flight loads were collected. of these, 535 flights representing 817.7 hours, provided USAble data. NASA developed the specifications for the recording system, defined the recording format, reduced the data to time histories of engineering units, and tested and evaluated the algorithms for data reduction and statistical reporting. The University of Dayton Research Institute (UDRI) received the flight loads data and data review software from NASA. UDRI developed soffware to reduce the flight loads data and obtain additional parameters such as derived gust velocity and continuous turbulence gust intensity. The data reduction includes, but is not limited to, analysis of e.g., accelerations, airspeeds, altitudes, flaps USAge, and takeoffs and landings. Data are typically presented in cumulative distribution function or cumulative counts normalized to nautical mile or 1000 hours. Comparisons of typical USAge with published FAR's are also presented.

DTIC

Data Acquisition; Algorithms; Aerodynamic Loads; Distribution Functions; Flight Recorders; Airspeed; Altitude

19970009594 Northrop Grumman Corp., Military Aircraft Div., Hawthorne, CA USA

Effects of Stiffener/Rib Separation on Damage Growth and Residual Strength ***Final Report, Sep. 1993 - Apr. 1994***

Kan, H. P., Northrop Grumman Corp., USA; Mahler, M., Northrop Grumman Corp., USA; May 1996; 55p; In English

Contract(s)/Grant(s): NAS1-19347

Report No.(s): AD-A310354; DOT/FAA/AR-95/12; NASA-CR-203502; NAS 1.26:203502; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Two existing composite aircraft structures were used to evaluate the effects of skin/stiffener separation on the residual strength of the structures. These structures are basically compression dominated upper wing structures designed to comply with the impact damage tolera nce requirements. The severity of impact damage and delaminations were analytically compared with that of skin/stiffener disbond. Critical disbond sizes were determined so that the residual strengths of the structures are comparable to those obtained from impact damage tolerance designs. A damage tolerance certification approach based on the results of this study was recommended. The approach is to prevent local buckling in the disbond region under the applied load that governs the damage tolerance design for impact damage and delaminations. This would lead to a critical disbond length for the structure that has the same residual strength capability as in the case of impact damage and delamination.

DTIC

Composite Structures; Residual Strength; Composite Materials; Ribs (Supports); Loads (Forces); Tolerances (Mechanics); Buckling; Aircraft Structures

19970010150 Stanford Univ., Dept. of Aeronautics and Astronautics, Palo Alto, CA USA

Aerodynamic Optimization of the High Speed Civil Transport ***Final Report***

Brawley, Stephen C., Stanford Univ., USA; Oct. 1996; 5p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The aerodynamic optimization program used for wing and fuselage optimization of the High Speed Civil Transport was modified for utilization of multiple processors on parallel processor computers. The modified version uses multiple processors to simultaneously conduct three-dimensional flow solutions of different wing and fuselage geometries for calculations of the gradient functions and for directional searches to minimize an objective function. Demonstrations have shown the parallel program to be useful for coarse grid optimization, however memory problems for processors on the IBM SP2 were encountered when finer grid sizes were used.

Author

Supersonic Transports; Three Dimensional Flow; Wings; Fuselages; Civil Aviation

19970010309 Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine, France

Structures and Materials Panel Working Group 27 on Evaluation of Loads from Operational Flight Maneuvers. Final Working Group Report (l'Evaluation des Charges Resultant des Manoeuvres en vol)

Apr. 1996; 123p; In English

Report No.(s): AD-A310890; AGARD-AR-340; ISBN-92-836-1030-X; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This AGARD Advisory Report describes an evaluation of a method to derive loads from operational flight maneuvers. The basic assumption of this method is that all operational maneuvers performed in service can be verified as a set of Standard Maneuvers (normalized parameter time histories for each independent maneuver type). The normalization procedure has been developed and applied to the data base for 3 GAF-aircraft in operation and one aircraft in development. The verification of Standard Maneuvers is based on recordings of relevant maneuver parameters in service and for new tactics/missions on special flights or simulations. For the verification process, data from the USAF and CF maneuver types have been identified and normalized. The comparison of the normalized maneuvers for several aircraft types leads to similar parameter time histories for the same maneuver type. The study has demonstrated for two Standard Maneuver types that load relevant parameters can be derived with sufficient accuracy for load calculations. Standard maneuvers derived from F- 16 data were reconstituted using F-18 control parameters. An F-18 loads calculation process has been verified against flight test data. A comparison of the input parameters and the resulting loads was carried out which showed reasonable correlation. The initial evaluation of the concept done by WG27 has demonstrated the feasibility of determining loads from operational flight maneuvers. Further work is necessary to expand the scope of the WG27 investigation and to confirm the WG27 conclusion.

DTIC

Flight Tests; Aircraft Design; Tactics

19970010328 Naval Postgraduate School, Monterey, CA USA

Civil Tiltrotor (CTR) Applications: A Dependence on Defense Development and Procurement of the MV-22 Osprey

Taylor, William E., Naval Postgraduate School, USA; Mar. 1996; 171p; In English

Report No.(s): AD-A309756; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Tiltrotor technology has been proven mature and technically feasible through well over 40 years of Government research and development, and three generations of tiltrotor aircraft. The Defense Department is moving forward with development of the MV-22 Osprey and should reach a full rate production decision in the near future. Despite a lucrative market for civil applications of tiltrotor technology, as of 1996, there has been no firm commitment to develop a civil tiltrotor (CTR). The purpose of this thesis was to examine whether Defense development and procurement of the MV-22 Osprey is a prerequisite to commercial development of a tiltrotor. This thesis focused on the barriers to introducing the CTR, and how Government efforts and the MV-22 have been influential in overcoming those barriers. There are two principal findings, first, tiltrotor technology has progressed to the point where CTR applications are dependent on the MV-22, only to the extent that without the benefit of MV-22 production, demonstration, and operational experience, the CTR's arrival will be significantly delayed. Second, technology is not the most critical consideration. The most critical barrier to successful fielding of a CTR, is a systems integration problem, primarily centered around the lack of a supporting infrastructure.

DTIC

Tilt Rotor Aircraft; Systems Integration; Tilting Rotors

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19970010304 Naval Postgraduate School, Monterey, CA USA
Unitary Joint Standoff Captive Air Training Missile Avionics Design Through Operational Concepts and Functional Requirements Analysis
Reilly, Dennis J., III, Naval Postgraduate School, USA; Mar. 1996; 145p; In English
Report No.(s): AD-A309753; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

To accurately simulate the Unitary Joint Standoff (JSOW) weapon functions and provide pilots with the most realistic training, the captive air training missile (CATM) avionics design will fully implement well defined operational concepts and functional requirements in terms of flight simulation characteristics, operational functions, pilot feedback, and electronic interfaces. This would provide the Navy, Marines, and Air Force with a single, multi-capable, light weight CATM that consolidates CATM procurement, decreases aircraft turnaround time and increases aircrew training per flight hour.
DTIC
Flight Simulation; Avionics; Education; Functional Design Specifications

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.

19970009487 NASA Lewis Research Center, Cleveland, OH USA
Modern Experimental Techniques in Turbine Engine Testing
Lepicovsky, J., NYMA, Inc., USA; Bruckner, R. J., NASA Lewis Research Center, USA; Bencic, T. J., NASA Lewis Research Center, USA; Braunscheidel, E. P., NASA Lewis Research Center, USA; Dec. 1996; 12p; In English; International Congress on Fluid Dynamics and Propulsion, 29-31 Dec. 1996, Cairo, Egypt; Sponsored by American Society of Mechanical Engineers, USA
Contract(s)/Grant(s): NAS3-27186; RTOP 505-62-10
Report No.(s): NASA-TM-107383; E-10572; NAS 1.15:107383; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The paper describes application of two modern experimental techniques, thin-film thermocouples and pressure sensitive paint, to measurement in turbine engine components. A growing trend of using computational codes in turbomachinery design and development requires experimental techniques to refocus from overall performance testing to acquisition of detailed data on flow and heat transfer physics to validate these codes for design applications. The discussed experimental techniques satisfy this shift in focus. Both techniques are nonintrusive in practical terms. The thin-film thermocouple technique improves accuracy of surface temperature and heat transfer measurements. The pressure sensitive paint technique supplies areal surface pressure data rather than discrete point values only. The paper summarizes our experience with these techniques and suggests improvements to ease the application of these techniques for future turbomachinery research and code verifications.
Author
Turbine Engines; Paints; Pressure Measurement; Thermocouples; Engine Tests; Temperature Measurement

19970009625 Pratt and Whitney Aircraft, East Hartford, CT USA
Impact of Periodic Unsteadiness on Performance and Heat Load in Axial Flow Turbomachines ***Final Report***
Sharma, Om P., Pratt and Whitney Aircraft, USA; Stetson, Gary M., Pratt and Whitney Aircraft, USA; Daniels, William A,, United Technologies Research Center, USA; Greitzer, Edward M., Massachusetts Inst. of Tech., USA; Blair, Michael F., United Technologies Research Center, USA; Dring, Robert P., United Technologies Research Center, USA; Jan. 1997; 302p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS3-25804; RTOP 538-06-14
Report No.(s): NASA-CR-202319; NAS 1.26:202319; E-10624; FR-24232; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

Results of an analytical and experimental investigation, directed at the understanding of the impact of periodic unsteadiness on the time-averaged flows in axial flow turbomachines, are presented. Analysis of available experimental data, from a large-scale rotating rig (LSRR) (low speed rig), shows that in the time-averaged axisymmetric equations the magnitude of the terms representing the effect of periodic unsteadiness (deterministic stresses) are as large or larger than those due to random unsteadiness (turbu-

lence). Numerical experiments, conducted to highlight physical mechanisms associated with the migration of combustor generated hot-streaks in turbine rotors, indicated that the effect can be simulated by accounting for deterministic stress like terms in the time-averaged mass and energy conservation equations. The experimental portion of this program shows that the aerodynamic loss for the second stator in a 1-1/2 stage turbine are influenced by the axial spacing between the second stator leading edge and the rotor trailing edge. However, the axial spacing has little impact on the heat transfer coefficient. These performance changes are believed to be associated with the change in deterministic stress at the inlet to the second stator. Data were also acquired to quantify the impact of indexing the first stator relative to the second stator. For the range of parameters examined, this effect was found to be of the same order as the effect of axial spacing.
Author
Turbomachinery; Unsteady Flow; Axial Flow; Unsteady Aerodynamics; Navier-Stokes Equation; Computational Fluid Dynamics

19970009632 NASA Lewis Research Center, Cleveland, OH USA
Three-Dimensional Flow Field Measurements in a Transonic Turbine Cascade
Giel, P. W., NYMA, Inc., USA; Thurman, D. R., Army Research Lab., USA; Lopez, I., Army Research Lab., USA; Boyle, R. J., NASA Lewis Research Center, USA; VanFossen, G. J., NASA Lewis Research Center, USA; Jett, T. A., NASA Lewis Research Center, USA; Camperchioli, W. P., NASA Lewis Research Center, USA; La, H., NASA Lewis Research Center, USA; Dec. 1996; 18p; In English; 41st; Gas Turbine and Aeroengine Congress, 10-13 Jun. 1996, Birmingham, UK; Sponsored by American Society of Mechanical Engineers, USA
Contract(s)/Grant(s): NAS3-27186; RTOP 523-26-13
Report No.(s): NASA-TM-107388; NAS 1.15:107388; ARL-TR-1252; E-10584; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Three-dimensional flow field measurements are presented for a large scale transonic turbine blade cascade. Flow field total pressures and pitch and yaw flow angles were measured at an inlet Reynolds number of 1.0 x 10(exp 6) and at an isentropic exit Mach number of 1.3 in a low turbulence environment. Flow field data was obtained on five pitchwise/spanwise measurement planes, two upstream and three downstream of the cascade, each covering three blade pitches. Three-hole boundary layer probes and five-hole pitch/yaw probes were used to obtain data at over 1200 locations in each of the measurement planes. Blade and endwall static pressures were also measured at an inlet Reynolds number of 0.5 x 10(exp 6) and at an isentropic exit Mach number of 1.0. Tests were conducted in a linear cascade at the NASA Lewis Transonic Turbine Blade Cascade Facility. The test article was a turbine rotor with 136 deg of turning and an axial chord of 12.7 cm. The flow field in the cascade is highly three-dimensional as a result of thick boundary layers at the test section inlet and because of the high degree of flow turning. The large scale allowed for very detailed measurements of both flow field and surface phenomena. The intent of the work is to provide benchmark quality data for CFD code and model verification.
Author
Three Dimensional Flow; Turbine Blades; Cascade Flow; Flow Distribution; Transonic Flow; Rotor Aerodynamics; Pressure Distribution; Wind Tunnel Tests

19970009820 NASA Lewis Research Center, Cleveland, OH USA
Imaging of Combustion Species in a Radially-Staged Gas Turbine Combustor
Locke, Randy J., NYMA, Inc., USA; Hicks, Yolanda R., NASA Lewis Research Center, USA; Anderson, Robert C., NASA Lewis Research Center, USA; Ockunzzi, Kelly A., Case Western Reserve Univ., USA; Schock, Harold J., Michigan State Univ., USA; Dec. 1996; 16p; In English; 33rd; Joint Combustion and Propulsion Systems Hazards Subcommittees Meeting, 4-9 Nov.1996, Monterey, CA, USA; Sponsored by NASA Lewis Research Center, USA
Contract(s)/Grant(s): NAS3-27186; RTOP 537-05-20
Report No.(s): NASA-TM-107373; NAS 1.15:107373; E-10542; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

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

Laser Induced Fluorescence; Flow Characteristics; Combustible Flow; Fuel Combustion; Hydrocarbon Combustion; Flow Measurement; Gas Turbine Engines

19970010096 Allison Engine Co., Indianapolis, IN USA
Combustor Design Model Evaluation ***Final Report, 1 Oct. 1987 - 31 Jan. 1996***
Anand, M. S., Allison Engine Co., USA; Pope, S. B., Cornell Univ., USA; Razdan, M. K., Allison Engine Co., USA; Apr. 1996; 149p; In English
Contract(s)/Grant(s): F33615-87-C-2821; AF Proj. 3048
Report No.(s): AD-A313656; EDDR-13417Q; WL-TR-96-2059; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The objective of the program was to evaluate, develop and validate more accurate computer-based analytical models for combustor flows to be used in combustor design. The joint velocity-scalar probability density function (pdf) method, which overcomes several key deficiencies of conventional turbulent combustion models and offers greater accuracy for combustor design calculations, is the focus of the program. Significant progress has been made under this program towards the development of the pdf method as a combustor design tool. Several new models and algorithms used in the pdf method have been developed. The method and the models have been validated in detail for a variety of flows, including swirling, recirculating and reacting flows, involving the essential features of gas turbine combustor flows. The validation was performed using available benchmark quality data, as well as data from specifically designed experiments which were performed at Wright Laboratory. A baseline pdf based combustor design system has been developed.
DTIC
Computerized Simulation; Mathematical Models; Turbulent Combustion; Algorithms; Gas Turbines; Computer Techniques; Combustion Physics; Combustion Chambers

19970010250 California Univ., Irvine, CA USA
Atomization and Dispersion of a Liquid Jet Injected Into a Crossflow of Air ***Final Report***
Seay, J. E., California Univ., USA; Samuelson, G. S., California Univ., USA; Nov. 1996; 160p; In English
Contract(s)/Grant(s): NAG3-1124; RTOP 537-05-20
Report No.(s): NASA-CR-198543; NAS 1.26:198543; E-10507; UCI-ARTR-95-4; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

In recent years, environmental regulations have become more stringent, requiring lower emissions of mainly nitrogen oxides (NOx), as well as carbon monoxide (CO) and unburned hydrocarbons (UHC). These regulations have forced the gas turbine industry to examine non-conventional combustion strategies, such as the lean burn approach. The reasoning behind operating under lean conditions is to maintain the temperature of combustion near and below temperatures required for the formation of thermal nitric oxide (NO). to be successful, however, the lean processes require careful preparation of the fuel/air mixture to preclude formation of either locally rich reaction zones, which may give rise to NO formation, or locally lean reaction zones, which may give rise to inefficient fuel processing. As a result fuel preparation is crucial to the development and success of new aeroengine combustor technologies. A key element of the fuel preparation process is the fuel nozzle. As nozzle technologies have developed, airblast atomization has been adopted for both industrial and aircraft gas turbine applications. However, the majority of the work to date has focused on prefilming nozzles, which despite their complexity and high cost have become an industry standard for conventional combustion strategies. It is likely that the new strategies required to meet future emissions goals will utilize novel fuel injector approaches, such as radial injection. This thesis proposes and demonstrates an experiment to examine, on a mechanistic level (i.e., the physics of the action), the processes associated with the atomization, evaporation, and dispersion of a liquid jet introduced, from a radial, plain-jet airblast injector, into a crossflow of air. This understanding requires the knowledge not only of what factors influence atomization, but also the underlying mechanism associated with liquid breakup and dispersion. The experimental data acquired identify conditions and geometries for improved performance of radial airblast injectors.
Author
Combustion Chambers; Fuel Injection; Atomizing; Aircraft Engines; Combustion; Combustion Temperature; Cross Flow; Gas Turbine Engines; Gas Turbines; Liquid Injection

19970010355 NASA Lewis Research Center, Cleveland, OH USA
The Effect of Wake Passing on Turbine Blade Film Cooling
Heidmann, James David, National Aeronautics and Space Administration. Lewis Research Center, USA; Dec. 1996; 270p; In English
Contract(s)/Grant(s): RTOP 523-26-13
Report No.(s): NASA-TM-107380; NAS 1.15:107380; E-10568; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The effect of upstream blade row wake passing on the showerhead film cooling performance of a downstream turbine blade has been investigated through a combination of experimental and computational studies. The experiments were performed in a steady-flow annular turbine cascade facility equipped with an upstream rotating row of cylindrical rods to produce a periodic wake field similar to that found in an actual turbine. Spanwise, chordwise, and temporal resolution of the blade surface temperature were achieved through the use of an array of nickel thin-film surface gauges covering one unit cell of showerhead film hole pattern. Film effectiveness and Nusselt number values were determined for a test matrix of various injectants, injectant blowing ratios, and wake Strouhal numbers. Results indicated a demonstratable reduction in film effectiveness with increasing Strouhal number, as well as the expected increase in film effectiveness with blowing ratio. An equation was developed to correlate the span-average film effectiveness data. The primary effect of wake unsteadiness was found to be correlated well by a chordwise-constant decrement of 0.094-St. Measurable spanwise film effectiveness variations were found near the showerhead region, but meaningful unsteady variations and downstream spanwise variations were not found. Nusselt numbers were less sensitive to wake and injection changes. Computations were performed using a three-dimensional turbulent Navier-Stokes code which was modified to model wake passing and film cooling. Unsteady computations were found to agree well with steady computations provided the proper time-average blowing ratio and pressure/suction surface flow split are matched. The remaining differences were isolated to be due to the enhanced mixing in the unsteady solution caused by the wake sweeping normally on the pressure surface. Steady computations were found to be in excellent agreement with experimental Nusselt numbers, but to overpredict experimental film effectiveness values. This is likely due to the inability to match actual hole exit velocity profiles and the absence of a credible turbulence model for film cooling.
Author
Turbine Blades; Film Cooling; Wakes; Navier-Stokes Equation; Computational Fluid Dynamics; Turbomachinery; Flow Distribution; Unsteady Aerodynamics

19970010360 NYMA, Inc., Brook Park, OH USA
SEADYN Analysis of a Tow Line for a High Altitude Towed Glider ***Final Report***
Colozza, Anthony J., NYMA, Inc., USA; Dec. 1996; 12p; In English
Contract(s)/Grant(s): NAS3-27186; RTOP 537-10-20
Report No.(s): NASA-CR-202308; NAS 1.26:202308; E-10589; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The concept of using a system, consisting of a tow aircraft, glider and tow line, which would enable subsonic flight at altitudes above 24 km (78 kft) has previously been investigated. The preliminary results from these studies seem encouraging. Under certain conditions these studies indicate the concept is feasible. However, the previous studies did not accurately take into account the forces acting on the tow line. Therefore in order to investigate the concept further a more detailed analysis was needed. The code that was selected was the SEADYN cable dynamics computer program which was developed at the Naval Facilities Engineering Service Center. The program is a finite element based structural analysis code that was developed over a period of 10 years. The results have been validated by the Navy in both laboratory and at actual sea conditions. This code was used to simulate arbitrarily-configured cable structures subjected to excitations encountered in real-world operations. The Navy's interest was mainly for modeling underwater tow lines, however the code is also USAble for tow lines in air when the change in fluid properties is taken into account. For underwater applications the fluid properties are basically constant over the length of the tow line. For the tow aircraft/glider application the change in fluid properties is considerable along the length of the tow line. Therefore the code had to be modified in order to take into account the variation in atmospheric properties that would be encountered in this application. This modification consisted of adding a variable density to the fluid based on the altitude of the node being calculated. This change in the way the code handled the fluid density had no effect on the method of calculation or any other factor related to the codes validation.
Author
Tethering; Finite Element Method; Towed Bodies; Computer Programs; Structural Analysis

08
AIRCRAFT STABILITY AND CONTROL

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

19970009700 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Gain-Scheduled Aircraft Control Using Linear Parameter-Varying Feedback
Breton, Martin R., Air Force Inst. of Tech., USA; Jun. 1996; 218p; In English
Report No.(s): AD-A308905; AFIT/GAE/ENY/96J-1; No Copyright; Avail: Issuing Activity (Defense Technical Information

Center (DTIC)), Microfiche

Systems which vary significantly over an operating envelope, such as fighter aircraft, generally cannot be controlled by a single linear time-invariant controller. As a result, gain-scheduling methods are employed to design control laws which can provide the desired performance. This thesis examines a relatively new approach to gain-scheduling, in which the varying controller is designed from the outset to guarantee robust performance, thereby avoiding the disadvantages of point designs. Specifically, the parameter-varying (LPV) aircraft model is linearized using linear fractional transformations (LFT's), and the resulting control problem is characterized as the solution to a set of four linear matrix inequalities (LMI's). The supporting theory is reviewed and two pitch-rate controllers are designed; one for the full longitudinal aircraft model, and another for the short period model. It is found that, even though the varying controllers are quite conservative, they can guarantee better robust performance over a large portion of an operating envelope when compared to time-invariant u-synthesis controllers.

DTIC

Aircraft Control; Feedback; Fighter Aircraft; Linear Transformations; Control Theory

19970010173 Arkansas Technical Univ., Russellville, AR USA

Use of the Matching Pursuit Algorithm for Flight Flutter Test Data Analysis ***Final Report***

Nelson, Ronald E., Arkansas Technical Univ., USA; Brenner, Martin, NASA Dryden Flight Research Center, USA; Oct. 1996; 4p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The goal of flight flutter testing is to detect possibly destructive modes of aircraft vibration which may arise during flight from interaction of aerodynamic forces with structural dynamic properties of the airframe. This is typically accomplished by exciting the airframe with a time varying force and monitoring the response of the aircraft throughout its flight envelope. The data generated must be analyzed and presented so that the frequency and time of occurrence of excited modes are clearly and unambiguously displayed. Processing and display in near real time is also desirable. Display of data in the time-frequency plane is a natural choice because it is a familiar and intuitive framework. The Matching Pursuit algorithm provides a time-frequency analysis with good adaptability to signal structure and good signal representation in the time-frequency plane. Improvements in efficiency are needed before the algorithm can be used in real time, however.

Derived from text

Algorithms; Data Acquisition; Flutter Analysis; Dynamic Characteristics; Flight Tests

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.

19970009831 Air Force Civil Engineering Support Agency, Tyndall AFB, FL USA

Typical Statement of Work for Airfield Pavement Condition Survey

Jun. 26, 1996; 16p; In English

Report No.(s): AD-A310964; ETL-96-3; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Procedures for Airfield Condition Surveys, describes the procedure for conducting airfield condition surveys and calculating Pavement Condition Indices. Attachment 1 to this ETL provides a typical statement of work for contracting this effort to private firms.

DTIC

Airports; Pavements; Surveys

19970010166 NASA Ames Research Center, Moffett Field, CA USA

Emission Spectral Measurements in the Plenum of an Arc Jet Wind Tunnel ***Final Report***

Donohue, Jim, Santa Clara Univ., USA; Fletcher, Doug, NASA Ames Research Center, USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Arc jet wind tunnel facilities are used to evaluate thermal protection system materials for re-entry vehicles. The high speed, high temperature flowfield generated by the arc jet can simulate the extreme aerodynamic heating environment experienced during re-entry so that the survivability of heat shield materials and performance of various designs options can be tested. Although the re-entry heating environment can be approximated in the arc jet facility, the flowfield only partially simulates the actual re-entry flight conditions. Reynolds numbers are not matched so that surface shear stress distributions and mass transfer rates due to ablation or other mechanisms are not modeled correctly. Unlike flight conditions the arc freestream air is in non-equilibrium

because of the rapid expansion that occurs in the supersonic nozzle. to properly study the actual re-entry flow environment, computational fluid dynamics, computational chemistry and radiation models must be used. Arc jet tunnel tests serve to validate these models. to perform accurate simulations inlet and boundary-conditions are needed, which come from measurements of the flowfield. The present study is concerned with measurements in the plenum region of an arc heater. In the past, conditions in the arc heater flowfield have been predicted using simulations since conventional measurement techniques could not be used in the harsh extremely high temperature environment. The present study is part of a recent push to utilize optical techniques to help better characterize the arc jet flowfields. Emission measurements have been made in the shock layer and the constrictor section of the arc heater to determine temperatures and species number densities. LIF measurements have been made in the free stream to determine temperature and velocity.
Author
Wind Tunnel Tests; Thermal Protection; Flow Distribution; Arc Heating; Shock Layers; Emission Spectra; Fiber Optics; Optical Measurement; Laser Induced Fluorescence

19970010291 Naval Air Warfare Center, Patuxent River, MD USA
Simulation Support of a 17.5 percent Scale F/A-18E/F Remotely Piloted Vehicle
Fitzgerald, Timothy R., Naval Air Warfare Center, USA; Feb. 27, 1996; 2p; In English
Report No.(s): AD-A307884; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

As defense budgets continue to shrink, cost-effective methods for the accurate and timely acquisition of aerodynamic data must be developed. Traditionally, wind tunnels have fulfilled this role at both the conceptual and developmental stages, as well as, throughout the service life of an aircraft. However, although wind tunnels are a trusted and valuable data source that provide consistent, repeatable data upon which to construct aerodynamic models, they also have inherent limitations such as blockage effects, wall and sting interference, and flow variations. Because of these constraints and due to the elevated angles-of-attack and sideslip that modern fighter aircraft are capable of, wind tunnels can be limited in their ability to cover an entire flight envelope . Another problem with the construction of aerodynamic models using wind tunnel data is the discontinuities that arise from the fundamental requirement for multiple -- and usually dissimilar -- data sources to construct a full-envelope model (rotary balance data combined with low-speed forced oscillation data; low-speed static data appended with supersonic data; and so on). A final problem that plagues wind tunnel testing, a problem that is likely to worsen given the recent closure of some facilities (e.g., NASA Langley's 3Ox6O tunnel), is the often limited availability of the resource; one wind tunnel facility can typically support many different platforms and programs, both civilian and military, and all of these must compete with one another for facility time.
DTIC
F-18 Aircraft; Angle of Attack; Rotary Stability; Remotely Piloted Vehicles; Flight Envelopes

19970010321 National Aerospace Lab., Advanced Aircraft Research Group, Tokyo, Japan
Technical Report of National Aerospace Laboratory
Hashidate, Masataka, National Aerospace Lab., Japan; Matsushita, Hiroshi, National Aerospace Lab., Japan; Ando, Yasukatsu, National Aerospace Lab., Japan; Kayaba, Shigeo, National Aerospace Lab., Japan; Fujiie, Kenji, National Aerospace Lab., Japan; Jul. 1996; ISSN 0389-4010; 19p; In Japanese
Report No.(s): NAL-TR-1299; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A tension controlled model suspension system was developed which is to be used in validation study of active control technology, giving a complete aircraft model a motion degree of freedom in the NAL Low-Speed Wind Tunnel. A torque motor on the tunnel ceiling suspends a model which moves along a rail vertically supported at the center of the wind tunnel test section. The system controls a cable tension constant against model motion in order to provide an aeroelastic similar model with motion similarity. Furthermore, this model makes it possible to give a restoring and a damping force arbitrarily by remote operation so that a model should fly around a center position without going out of the test section. The system was successfully used in the wind tunnel tests for gust load alleviation of a complete aircraft aeroelastic model and its effective functions were verified. This report describes the structure, the performance, and the applications of the system.
Author
Active Control; Wind Tunnel Tests; Wind Tunnel Models; Aeroelasticity; Gust Loads

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.

19970009607 CFD Research Corp., Huntsville, AL USA
Influence of Supercritical Conditions on Precombustion Chemistry and Transport Behavior of Jet Fuels ***Final Report, 25 Sep. 1993 - 24 May 1996***
Zhou, N., CFD Research Corp., USA; Krishnan, A., CFD Research Corp., USA; Apr. 1996; 175p; In English
Contract(s)/Grant(s): F49620-93-C-0067; AF Proj. 3005
Report No.(s): AD-A310358; AFOSR-TR-96-0319; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

An experimental/computational approach to model precombustion chemistry and transport behavior for hydrocarbon fuels under supercritical conditions was developed. Models for the computation of thermophysical properties of real fluids were incorporated into a general purpose computational fluid dynamics (CFD) code. The models were applied to analyze heat transfer in supercritical fluids over a range of flow conditions from the laminar to turbulent regimes. The effects of turbulence and buoyancy were studied in detail. Advanced thermal stability models for jet fuels were incorporated into the code. Model predictions were compared with deposition data in the literature and with a concurrent experimental study. Experiments were performed at the University of Iowa and at Wright Laboratory using jet fuels and sulfur hexafluoride.
DTIC
Computational Fluid Dynamics; Thermophysical Properties; Turbulence Effects; Supercritical Fluids; Sulfur Hexafluoride; Turbulence; Jet Engine Fuels; Hydrocarbon Fuels

19970009808 Alpha STAR Corp., Los Angeles, CA USA
Multi-Disciplinary Development of a Smart CMC Combustor for an Intelligent Engine System
Abdi, Frank, Alpha STAR Corp., USA; Lorenz, Roy, Alpha STAR Corp., USA; Hadian, Jeff, Alpha STAR Corp., USA; Niska, Harvey, Allied-Signal Aerospace Co., USA; Nov. 1996; 102p; In English
Contract(s)/Grant(s): NAS3-27443; RTOP-505-63-5B
Report No.(s): NASA-CR-198548; NAS 1.26:198548; E-10535; ASC-95-1002; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The findings are described of an investigation to determine the feasibility of utilizing temperature and/or strain and stress sensor data in a computer program to monitor the health, in real time, of a ceramic gas turbine combustor operating at elevated temperatures (greater than 20,000 F). The ultimate purpose is to provide feedback to initiate corrective action should a threat to combustor health occur. This investigation evaluates the feasibility of the following: (1) Selection of sensor technology and CMC material for potential use in developing a smart CMC combustor, (2) development of a finite element simulation model of a sensor equipped, smart, CMC combustor based on and verified with test data, (3) use of simulation model and GENOA, NESSUS and CEMCAN available computer codes, to calibrate, and perform: (1) finite element analysis to predict CMC combustor structural response under load, (2) probabilistic analysis of the CMC combustor operating with benefit of sensor input, (3) probabilistic determination of sensor influence coefficients needed to enhance existing CEMCAN code capability for prediction of the structural response of a CMC combustor with embedded sensors, (4) modification of existing CMC data bank using CEMCAN to account for material property changes due to embedded sensors, and (5) use of GENOA to assist in design of a ceramic combustor for a gas turbine engine. Results obtained establish the feasibility of every item enumerated above.
Author
Ceramic Matrix Composites; Combustion Chambers; Gas Turbine Engines; High Temperature; Operating Temperature; Fiber Composites; Systems Health Monitoring

19970010170 California State Polytechnic Univ., Air Breathing Propulsion; Dept. of Aerospace Engineering, Pomona, CA USA
Performance of Soviet NK-321, Mixed Stream, Triple Spool, Augmented Turbofan Engine
Kauser, Fazal B., California State Polytechnic Univ., USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

In 1 960's it became clear to the Russian that subsonic Strategic bomber 'Tu-95 Bear' had only a limited life in term of their ability to penetrate modern air defense systems. Thus, there was a need for a new, large bomber with variable sweep wings, which would make it possible to have an efficient and economical subsonic cruise in combination with a supersonic dash capability at high altitudes and near sonic dash capability at tree-top altitude. The design studies led to the development of Tu-160 long range strategic bomber with the NATO code name 'Blackjack'. Blackjack made its public debut at Tushino in august 1989, when one took part in the 'Aviation

Day' fly-past. Despite this public presentation, very little information has been released about this aircraft and its propulsion system The interesting point to note is that external aerodynamic shape of the Blackjack closely resembles Rockwell International B-l . Blackjack is, however, much bigger than American B-l-A or B-l-B. The objective of this research is to estimate the performance of Soviet NK-321 engine using NASA/Navy Engine Simulation Program 'NNEP89'. Owing to lack of information on some of the key design parameters, the author has to rely on his own experience and speculate a base-line engine to perform off-design cycle analysis of the Soviet NK-321 engine.
Derived from text
Design Analysis; Engine Design; Turbofan Engines; Simulation; Bomber Aircraft

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.

19970009493 NASA Ames Research Center, Moffett Field, CA USA
Convergence Acceleration of a Navier-Stokes Solver for Efficient Static Aeroelastic Computations
Obayashi, Shigeru, NASA Ames Research Center, USA; Guruswamy, Guru P., NASA Ames Research Center, USA; AIAA Journal; Jun. 1995; Volume 33, No. 6, pp. 1134-1141; In English; 25th; Fluid Dynamics Conference, 20-23 Jun. 1994, Colorado Springs, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NCC2-605
Report No.(s): NASA-CR-203337; NAS 1.26:203337; AIAA Paper 94-2268; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

New capabilities have been developed for a Navier-Stokes solver to perform steady-state simulations more efficiently. The flow solver for solving the Navier-Stokes equations is based on a combination of the lower-upper factored symmetric Gauss-Seidel implicit method and the modified Harten-Lax-van Leer-Einfeldt upwind scheme. A numerically stable and efficient pseudo-time-marching method is also developed for computing steady flows over flexible wings. Results are demonstrated for transonic flows over rigid and flexible wings.
Author
Navier-Stokes Equation; Computational Fluid Dynamics; Aeroelasticity; Upwind Schemes (Mathematics); Steady State; Convergence

19970009612 North Carolina State Coll., Raleigh, NC USA
Experimental and Computational Aerothermodynamics of a Mars Entry Vehicle
Hollis, Brian R., North Carolina State Coll., USA; Dec. 1996; 638p; In English
Contract(s)/Grant(s): NAG1-1663; NAGw-1331; RTOP 242-80-01-01
Report No.(s): NASA-CR-201633; NAS 1.26:201633; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

An aerothermodynamic database has been generated through both experimental testing and computational fluid dynamics simulations for a 70 deg sphere-cone configuration based on the NASA Mars Pathfinder entry vehicle. The aerothermodynamics of several related parametric configurations were also investigated. Experimental heat-transfer data were obtained at hypersonic test conditions in both a perfect gas air wind tunnel and in a hypervelocity, high-enthalpy expansion tube in which both air and carbon dioxide were employed as test gases. In these facilities, measurements were made with thin-film temperature-resistance gages on both the entry vehicle models and on the support stings of the models. Computational results for freestream conditions equivalent to those of the test facilities were generated using an axisymmetric/2D laminar Navier-Stokes solver with both perfect-gas and nonequilibrium thermochemical models. Forebody computational and experimental heating distributions agreed to within the experimental uncertainty for both the perfect-gas and high-enthalpy test conditions. In the wake, quantitative differences between experimental and computational heating distributions for the perfect-gas conditions indicated transition of the free shear layer near the reattachment point on the sting. For the high enthalpy cases, agreement to within, or slightly greater than, the experimental uncertainty was achieved in the wake except within the recirculation region, where further grid resolution appeared to be required. Comparisons between the perfect-gas and high-enthalpy results indicated that the wake remained laminar at the high-enthalpy test conditions, for which the Reynolds number was significantly lower than that of the perfect-gas conditions.
Author
Aerothermodynamics; Computational Fluid Dynamics; Forebodies; Navier-Stokes Equation; Computerized Simulation; Mars Pathfinder

19970009619 NASA Lewis Research Center, Cleveland, OH USA

The Effects of Acoustic Treatment on Pressure Disturbances From a Supersonic Jet in a Circular Duct

Dahl, Milo D., NASA Lewis Research Center, USA; Nov. 1996; 24p; In English; International Mechanical Engineering Congress and Exposition, 17-22 Nov. 1996, Atlanta, GA, USA; Sponsored by American Society of Mechanical Engineers, USA

Contract(s)/Grant(s): RTOP 505-62-52

Report No.(s): NASA-TM-107358; NAS 1.15:107358; E-10513; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The pressure disturbances generated by an instability wave in the shear layer of a supersonic jet are studied for an axisymmetric jet inside a lined circular duct. For the supersonic jet, locally linear stability analysis with duct wall boundary conditions is used to calculate the eigenvalues and the eigenfunctions at each axial location. These values are used to determine the growth rates and phase velocities of the instability waves and the near field pressure disturbance patterns. The study is confined to the dominant Kelvin-Helmholtz instability mode and to the region just downstream of the nozzle exit where the shear layer is growing but is still small in size compared to the radius of the duct. Numerical results are used to study the effects of changes in the outer flow, growth in the shear layer thickness, wall distance, and wall impedance, and the effects of these changes on non-axisymmetric modes. The primary results indicate that the effects of the duct wall on stability characteristics diminish as the outer flow increases and as the jet azimuthal mode number increases. Also, wall reflections are reduced when using a finite impedance boundary condition at the wall; but in addition, reflections are reduced and growth rates diminished by keeping the imaginary part of the impedance negative when using the negative exponential for the harmonic dependence.

Author

Supersonic Jet Flow; Ducts; Ducted Flow; Duct Geometry; Circles (Geometry); Boundary Conditions; Kelvin-Helmholtz Instability; Supersonic Inlets

19970010149 Purdue Univ., School of Aeronautics and Astronautics, West Lafayette, IN USA

Simulation and Modeling of the Elliptic Streamline Flow ***Final Report***

Blaisdell, Gregory A., Purdue Univ., USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Direct numerical simulation (DNS) was used to study homogeneous turbulence with a mean flow having elliptic streamlines. This flow combines the effects of rotation and strain on the turbulence. There are many important reasons for studying the elliptic streamline flow. This flow contains the effects of both rotation and strain and is therefore similar to the mean flow in a vortex strained in the plane perpendicular to its axis. Such flows provide insight into the fundamental vortical interactions within turbulence. A strained vortex also occurs in airplane wakes, in which each wingtip vortex induces a strain field on the other. The strain field can affect the stability of these vortices and thereby their turbulent structure downstream. The ability to understand and predict the turbulent structure of the vortices is important to the wake hazard problem which is of major concern for the safety of commercial aircraft.

Derived from text

Homogeneous Turbulence; Wing Tips; Wakes; Laminar Flow; Mathematical Models; Computerized Simulation; Rotation

19970010277 Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine, France

Progress and Challenges in CFD Methods and Algorithms ***Progres Realises et Defis en Methodes et Algorithmes CFD***

Apr. 1996; 473p; In English; 77th; Fluid Dynamics Panel Symposium, 2 - 5 Oct. 1995, Seville, Spain

Report No.(s): AD-A310874; AGARD-CP-578; No Copyright; Avail: CASI; A20, Hardcopy; A04, Microfiche

Partial contents include: (1) CFD Research in the Changing U.S. Aeronautical Industry; (2) Parallel Computing in Computational Fluid Dynamics; (3) Portable Parallelization of a 3D Euler/Navier-Stokes Solver for Complex Flows; (4) Spectral Multi-Domain Solver Suitable for DNS and LES Numerical Simulation of Incompressible Flows; (5) On Improving Parallelism in the Transonic Unsteady Rotor Navier Stokes (TURNS) Code; (6) Development of a Parallel Implicit Algorithm for CFD Calculations; (7) Experiments with Unstructured Grid Computations; (8) A Second-Order Finite-Volume Scheme Solving Euler and Navier-Stokes Equations on Unstructured Adaptive Grids with an Implicit Acceleration Procedure; (9) Numerical Simulation of Internal and External Gas Dynamic Flows on Structured and Unstructured Adaptive Grids; (10) An Investigation of the Effects of the Artificial Dissipation Terms in a Modern TVD Scheme on the Solution of a Viscous Flow Problem; (11) A Flux Filter Scheme Applied to the Euler and Navier Stokes Equations; (12) Implicit Multidimensional Upwind Residual Distribution Schemes on Adaptive Meshes; (13) Multidimension al Upwind Dissipation for 2D/3D Euler/Navier-Stokes Applications; (14) Iteration for High Order and Fast Solution of 3-D Navier-Stokes Equations; (15) Convergence Acceleration of the Navier-Stokes Equations through Time-Derivative Preconditioning; (16) Parallel Algorithms for DNS of Compressible Flow; (17) A Straightforward 3D Multi-Block Unsteady Navier-Stokes Solver for Direct and Large- Eddy Simulations of Transitional and Turbulent

Compressible Flows; (18) Applications of Lattice Boltzmann Methods to Fluid Dynamics; (19) Transition in the Case of Low Free Stream Turbulence; and (20) Multiblock Structured Grid Algorithms for Euler Solvers in a Parallel Computing Framework. DTIC

Parallel Processing (Computers); Computational Fluid Dynamics; Aerodynamic Drag; Mathematical Models

14
LIFE SCIENCES

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

19970009457 United Technologies Corp., Windsor Locks, CT USA

SPE OBOGS: On-board Oxygen Generating System

Smith, William F., United Technologies Corp., USA; McElroy, James F., United Technologies Corp., USA; Space Electrochemical Research and Technology; Dec. 1996, pp. 133-146; In English; Also announced as 19970009446; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Regulations require oxygen USAge by commercial airliners during check out and during certain aircraft configurations. This oxygen is drawn from a high pressure on-board cylinder storage system. In a typical aircraft, oxygen cylinder removal for oxygen ground servicing is conducted every 4 to 6 weeks. In the early 1990's, it was recognized that an on-board oxygen generating system (OBOGS) could provide an economic advantage for the airlines. An in-flight service evaluation (ISE) of the SPE-OBOGS by United Technologies Corporate is in the planning stage.

Derived from text

Airline Operations; Commercial Aircraft; Oxygen Supply Equipment; Cost Effectiveness; Electrolysis; Certification

19970010153 Rochester Inst. of Tech., Dept. of Mechanical Engineering, NY USA

Development of a Driver Code for the WICS Project ***Final Report***

Ghosh, Amitabha, Rochester Inst. of Tech., USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Wall Interference Correction System (WICS) is a computational technique to evaluate the wind tunnel wall interference corrections for blockage, Mach number, dynamic pressure and angle of attack. The objective is to predict the effects of the bounding walls on wind tunnel measurements [1]. The procedure attempts to compute these corrections in real time so that the test engineer can implement these by adjusting wind tunnel controls for angle of attack and dynamic pressure while the test is in progress in the 12 ft. pressure wind tunnel at the Ames Research Center. The technique utilizes an ideal flow solver PMARC (Panel Method developed at the Ames Research Center) to compute influence coefficients in an internal flow mode by representing a paneled model of the tunnel for fullspan and semispan tests.

Derived from text

Wind Tunnel Walls; Wind Tunnel Tests; Wall Flow; Panel Method (Fluid Dynamics); Dynamic Pressure; Aerodynamic Interference; Angle of Attack

19970010159 Houston Univ., Dept. Human Development, TX USA

Calcium Balance in Mature Rats Exposed to a Space Flight Model ***Final Report***

Wolinsky, Ira, Houston Univ., USA; Oct. 1996; 4p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Negative calcium balances are seen in humans during spaceflight and bed rest, an analog of space flight. Due to the infrequency and costliness of space flight and the difficulties, cost, and restraints in using invasive procedures in bed rest studies, several ground based animal models of space flight have been employed. The most useful and well developed of these models is hind limb unloading in the rat. In this model the hind limbs are non-weight bearing (unloaded) but still mobile; there is a cephalad fluid shift similar to that seen in astronauts in flight; the animals are able to feed, groom and locomote using their front limbs; the procedure is reversible; and, importantly, the model has been validated by comparison to space flight. Several laboratories have studied calcium balance using rats in hind limb unweighting. Roer and Dillaman used young male rats to study calcium balance in this model for 25 days. They found no differences in dietary calcium intake, percent calcium absorption, urinary and fecal excretion, hence indicating no differences in calcium balance between control and unloaded rats. In another study, employing 120 day old females, rats' hind limbs were unloaded for 28 days. While negative calcium balances were observed during a 25 day recovery period no balance measurements were possible during unweighting since the researchers did not employ appropriate metabolic

cages. In a recent study from this laboratory, using 200 g rats in the space flight model for two weeks, we found depressed intestinal calcium absorption and increased fecal calcium excretion (indicating less positive calcium balances) and lower circulating 1,25-dihydroxyvitamin D. The above studies indicate that there remains a dearth of information on calcium balance during the hind limb unloading rat space flight model, especially in mature rats, whose use is a better model for planned manned space flight than juvenile or growing animals. With the aid of a newly designed metabolic cage developed in our laboratory it is now possible to accurately measure urinary and fecal calcium excretions in this space flight model. The purpose of this study, then, was to extend and enlarge our previous findings viz: to measure calcium balances in mature rats exposed to a space flight model.
Author
Calcium; Space Flight; Flight Simulation; Physiological Effects; Rats

19970010162 Stanford Univ., Dept. of Aeronautics and Astronautics, Palo Alto, CA USA
Welcome to Webpress ***Final Report***
Oct. 1996; 2p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

A World Wide Web page, Webpress, designed for K-12 teachers is described. The primary emphasis of Webpress is the science of aeronautics, and the page includes many links to various NASA facilities as well as many other scientific organizations.
Derived from text
Aeronautics; Internets; World Wide Web

19970010181 Ohio State Univ., Columbus, OH USA
Loss of Situation Awareness in Pilots: Analysis of Incident Reports ***Final Report***
Villeda, Eric B., Ohio State Univ., USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Introduction Approximately 75% of all aviation accidents and incidents are attributable to human failures in monitoring, managing, and operating system. Tactical decision errors were found to be a factor in 25 of 37 major US air transport accidents between 1978 and 1990. These two facts demonstrate the inability of some pilots to maintain situation awareness. Situation awareness (SA) is defined as 'the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future". Thus, when a pilot loses SA, he or she is unable to ether perceive, comprehend, or project the status of the aircraft. In pilots terms, he or she has 'fallen behind the airplane'. Our study this summer involved an analysis of 190 NASA Aviation Safety Reporting System (ASRS) reports.
Derived from text
Aircraft Accidents; Aircraft Safety; Flight Safety

19970010293 Logicon Technical Services, Inc., Dayton, OH USA
Developing Virtual Interfaces for Use in Future Fighter Aircraft Cockpits ***Interim Report, 1 Jul. 1993 - 1 Jul 1994***
Hass, Michael W., Armstrong Lab., USA; Nelson, W. Todd, Logicon Technical Services, Inc., USA; Hettinger, Lawrence J., Logicon Technical Services, Inc., USA; Jul. 1995; 110p; In English
Contract(s)/Grant(s): F41624-94-D-6000; AF Proj. 7184
Report No.(s): AD-A307887; AL/CF-TR-1995-0154; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The current research was conducted to evaluate the effect of employing multi-sensory displays for fighter aircraft cockpit on the performance of a simulated air combat task. Each of four experienced U.S. Air Force F-16 pilots flew twelve simulated missions which required them to locate and destroy four enemy bombers whose flight path was pre-programmed. Simultaneously, two other pilots were assigned to auxiliary cockpits in the laboratory and flew enemy fighter aircraft in an attempt to intercept and shoot down the primary pilot. Each pilot flew six trials using a cockpit comprised of conventional F-15 flight instruments and six trials using a modified, multi-sensory cockpit. The latter configuration included three-dimensional sound cueing information specifying the location of enemy aircraft, a head-slaved head-up display, a schematic representation of the terrain that provided pictorial information about self-motion an altitude, a spatial representation of the location of enemy and friendly aircraft in the vicinity, a pictorial representation of the status of aircraft weapons systems, and a multi-sensory Ground Collision Avoidance System. The results indicate tha pilot performance and situational awareness were enhanced with the multi-sensory cockpit as opposed to the conventional cockpit. This report also contains a summary of the effects of changes in tactics and new control and display technology on the development of multi-sensory crewstations.
DTIC
Cockpits; Crew Workstations; Display Devices; F-15 Aircraft; F-16 Aircraft; Flight Instruments; Head-Up Displays; Pilot Performance

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.

19970010157 Ohio State Univ., Dept. of Psychology, Columbus, OH USA
The Role of Risk in Pilot's Perceptions of Problem Situations ***Final Report***
Nygren, Thomas E., Ohio State Univ., USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

During the next decade, a number of dramatic changes are planned for the commercial aviation system. These changes will encompass both operational and technological advancements. One planned operational change of great potential significance is referred to as Advanced Air Traffic Technology (AATT) or 'free flight' - an advancement, which, when in place, will give airlines and flight crews more freedom in choosing and dynamically changing their optimal travel routes. Although free-flight has the stated goal of more flexibility of operations for commercial airlines while maintaining the highest levels of safety, it will necessarily require a much greater sharing of responsibility for safe use of airspace on the part of airline flight managers, air traffic controllers, and aircraft flight crews. The increased flexibility of free-flight suggests that flight crews may be faced with higher levels of workload and may be required to make more complex sequential and timeconstrained dynamic decisions. With this increase in both number and difficulty of decisions comes the potential for decision related problems for commercial flight crews. Flight-related problems that require some kind of crew decision making are already being reported with high frequency as incident reports to the Aviation Safety Reporting System (ASRS). These ASRS incident reports are extremely valuable because they can suggest situations or circumstances that are potentially problematic from a safety perspective and which might require operational changes on the part of the FAA, ATC, the airlines, or the flight crews. A significant number of these incidents appear to have high enough levels of safety risk or time pressure associated with them to produce difficulty in pilot decision making.
Author
Aircraft Safety; Risk; Decision Making; Civil Aviation; Commercial Aircraft; Free Flight; Pilot Performance

19970010161 California Polytechnic State Univ., Dept. of Aeronautical Engineering, San Luis Obispo, CA USA
Webpress: An Internet Outreach from NASA Dryden ***Final Report***
Biezad, Daniel J., California Polytechnic State Univ., USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The Technology and Commercialization Office at NASA DRyden has developed many educational outreach programs for K-12 educators. This project concentrates on the internet portion of that effort, specifically focusing on the development of an internet tool for educators called Webpress. This tool will not only provide a user-friendly access to aeronautical topics and interesting individuals on the world wide web (web), but will also enable teachers to rapidly submit and display their own materials and links for use in the classroom.
Derived from text
Internets; Aeronautics; Education; World Wide Web

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.

19970010251 NASA Lewis Research Center, Cleveland, OH USA
Time-Dependent Parabolic Finite Difference Formulation for Harmonic Sound Propagation in a Two-Dimensional Duct with Flow
Kreider, Kevin L., NASA Lewis Research Center, USA; Baumeister, Kenneth J., Akron Univ., USA; Nov. 1996; 17p; In English
Contract(s)/Grant(s): RTOP-505-62-52
Report No.(s): NASA-TM-107363; NAS 1.15:107363; E-10525; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An explicit finite difference real time iteration scheme is developed to study harmonic sound propagation in aircraft engine nacelles. to reduce storage requirements for future large 3D problems, the time dependent potential form of the acoustic wave equation is used. to insure that the finite difference scheme is both explicit and stable for a harmonic monochromatic sound field, a parabolic (in time) approximation is introduced to reduce the order of the governing equation. The analysis begins with a har-

monic sound source radiating into a quiescent duct. This fully explicit iteration method then calculates stepwise in time to obtain the 'steady state' harmonic solutions of the acoustic field. For stability, applications of conventional impedance boundary conditions requires coupling to explicit hyperbolic difference equations at the boundary. The introduction of the time parameter eliminates the large matrix storage requirements normally associated with frequency domain solutions, and time marching attains the steady-state quickly enough to make the method favorable when compared to frequency domain methods. For validation, this transient-frequency domain method is applied to sound propagation in a 2D hard wall duct with plug flow.
Author
Finite Difference Theory; Sound Propagation; Aircraft Engines; Aeroacoustics; Real Time Operation; Engine Inlets; Ducted Flow; Iterative Solution

19970010367 NASA Lewis Research Center, Cleveland, OH USA
Characteristics of Residual Mixing Noise From Internal Fan/Core Mixers
Krejsa, Eugene A., NASA Lewis Research Center, USA; Saiyed, Naseem H., NASA Lewis Research Center, USA; Jan. 1997; 25p; In English; 35th; Aerospace Sciences Meeting and Exhibit, 6-10 Jan. 1997, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 538-03-11
Report No.(s): NASA-TM-107395; NAS 1.15:107395; AIAA Paper 97-0382; E-10600; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The jet mixing noise from two fan/core mixer nozzles is studied. Acoustic data from two fan/core mixer nozzles are analyzed to determine the properties of the noise signatures. It was assumed that there were three major contributors to the total noise signature: noise from mixing of the fan and core streams internal to the nozzle; noise from residual mixing of the fan and core streams external to the nozzle; and the noise associated with the fully mixed jet. In general, the low frequency portion of the noise spectra can be associated with the fully mixed jet and can be predicted using an empirical correlation for single round nozzle jet noise. The properties of the noise in excess of the fully mixed levels are studied.
Author
Aeroacoustics; Acoustic Properties; Aerodynamic Noise; Jet Aircraft Noise; Jet Mixing Flow; Noise Measurement; Mixers

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.

19970010148 Missouri Univ., Physics Dept., Rolla, MO USA
Analytic Methods for Predicting Significant Multi-Quanta Effects in Collisional Molecular Energy Transfer ***Final Report***
Bieniek, Ronald J., Missouri Univ., USA; Oct. 1996; 3p; In English; Also announced as 19970010146; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Collision-induced transitions can significantly affect molecular vibrational-rotational populations and energy transfer in atmospheres and gaseous systems. This, in turn. can strongly influence convective heat transfer through dissociation and recombination of diatomics. and radiative heat transfer due to strong vibrational coupling. It is necessary to know state-to-state rates to predict engine performance and aerothermodynamic behavior of hypersonic flows, to analyze diagnostic radiative data obtained from experimental test facilities, and to design heat shields and other thermal protective systems. Furthermore, transfer rates between vibrational and translational modes can strongly influence energy flow in various 'disturbed' environments, particularly where the vibrational and translational temperatures are not equilibrated.
Derived from text
Convective Heat Transfer; Aerothermodynamics; Radiative Heat Transfer; Hypersonic Flow; Heat Shielding; Energy Transfer

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SOCIAL SCIENCES

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

19970010146 Stanford Univ., Dept. of Aeronautics and Astronautics, Palo Alto, CA USA
1996 NASA-ASEE-Stanford Summer Faculty Fellowship Program, Part 1 ***Final Report***
Oct. 1996; 116p; In English; Also announced as 19970010147 through 19970010181
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As is customary, the final technical report for the NASA-ASEE Summer Faculty Fellowship Program at the Ames Research Center, Dryden Flight Research Center and Stanford University essentially consists of a compilation of the summary technical reports of all the fellows. More extended versions done either as NASA publications, archival papers, or other laboratory reports are not included here. The reader will note that the areas receiving emphasis were the life sciences, astronomy, remote sensing, aeronautics, fluid dynamics/aerophysics, and computer science. of course, the areas of emphasis vary somewhat from year to year depending on the interests of the most qualified applicants. Once again, the work is of especially high quality. The reports of the first and second year fellows are grouped separately and are arranged alphabetically within each group.
Derived from text
Remote Sensing; Fluid Dynamics; Life Sciences; Aeronautics

Subject Term Index

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