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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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

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05 Aircraft Design, Testing and Performance **4**

Includes aircraft simulation technology.

06 Aircraft Instrumentation **6**

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07 Aircraft Propulsion and Power **7**

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08 Aircraft Stability and Control **8**

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18 Space Sciences **N.A.**

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Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RT

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 343)

MARCH 7, 1997

01
AERONAUTICS

19970009247 Advisory Group for Aerospace Research and Development, Fluid Dynamics Panel, Neuilly-Sur-Seine, France
Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles ***l'Integration de la Propulsion et de l'Aerodynamique pour les Vehicules Hypersoniques***
Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 422p; In English, 15-19 Apr. 1996, Rhode-Saint-Genese, Belgium; Also announced as 19970009248 through 19970009260
Report No.(s): AGARD-R-813; Copyright Waived; Avail: CASI; A18, Hardcopy; A04, Microfiche

Lecture for the AGARD Fluid Dynamics Panel (FDP) Special Course on 'Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles' have been assembled in this report. The following topics are covered: Aerothermodynamics of radiation-cooled surfaces; real-gas and strong interaction phenomena; hypersonic laminar-turbulent transition and turbulence modeling; configurational aerothermodynamics of reentry vehicles (winged and capsule) as well as RAM and SCRAM propelled vehicles; RAM and SCRAM inlet and propulsion integration; hypersonic missile aerothermodynamics and stage separation for two-stage launch configurations. In addition, the Hypersonic Aerothermodynamic Program at VKI was presented as well as a Navier Stokes-solver for hypersonic applications. The material assembled in this report was prepared under the combined sponsorship of the AGARD Fluid Dynamics Panel, the Consultant and Exchange Program of AGARD, and the von Karman Institute (VKI) for Fluid Dynamics.
Author
Aerothermodynamics; Hypersonic Flow; Stage Separation; Turbulence Models; Computational Fluid Dynamics; Navier-Stokes Equation; Boundary Layer Transition; Supersonic Combustion Ramjet Engines; Flow Distribution

02
AERODYNAMICS

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

19970007188 NASA Langley Research Center, Hampton, VA USA
Low-Speed Wind Tunnel Tests of Two Waverider Configuration Models
Pegg, Robert J., NASA Langley Research Center, USA; Hahne, David E., NASA Langley Research Center, USA; Cockrell,Charles E., Jr., NASA Langley Research Center, USA; 1995; 18p; In English; 6th; International Aerospace and Hypersonics Technologies, 3-7 Apr. 1995, Chattanooga, TN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): NASA-TM-111795; NAS 1.15:111795; AIAA Paper 95-6093; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

A definitive measurement of the low-speed flight characteristics of waverider-based aircraft is required to augment the overall design database for this important class of vehicles which have great potential for efficient high-speed flight. Two separate waverider-derived vehicles were tested; one in the 14- by 22-Foot Tunnel and the other in the 12-Foot Low Speed Tunnel at Langley Research Center. These tests provided measurements of moments and forces about all three axes, control effectiveness, flow field characteristics and the effects of configuration changes. The results of these tunnel tests are summarized and the subsonic aerodynamic characteristics of the two configurations are shown.
Author (revised)
Wind Tunnel Tests; Waveriders; Aircraft Configurations; Subsonic Speed; Angle of Attack; Pitching Moments; Flight Characteristics; Lateral Stability; Directional Stability; Lift Drag Ratio; Aerodynamic Stability; Aerodynamic Characteristics

19970008124 NASA Langley Research Center, Hampton, VA USA

Computer Program to Obtain Ordinates for NACA Airfoils

Ladson, Charles L., NASA Langley Research Center, USA; Brooks, Cuyler W., Jr., NASA Langley Research Center, USA; Hill, Acquilla S., NASA Langley Research Center, USA; Sproles, Darrell W., Computer Sciences Corp., USA; Dec. 1996; 23p; In English

Contract(s)/Grant(s): RTOP 505-59-10-31

Report No.(s): NASA-TM-4741; L-17509; NAS 1.15:4741; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Computer programs to produce the ordinates for airfoils of any thickness, thickness distribution, or camber in the NACA airfoil series were developed in the early 1970's and are published as NASA TM X-3069 and TM X-3284. For analytic airfoils, the ordinates are exact. For the 6-series and all but the leading edge of the 6A-series airfoils, agreement between the ordinates obtained from the program and previously published ordinates is generally within 5 x 10(exp -5) chord. Since the publication of these programs, the use of personal computers and individual workstations has proliferated. This report describes a computer program that combines the capabilities of the previously published versions. This program is written in ANSI FORTRAN 77 and can be compiled to run on DOS, UNIX, and VMS based personal computers and workstations as well as mainframes. An effort was made to make all inputs to the program as simple as possible to use and to lead the user through the process by means of a menu. Author

Computer Programs; Airfoil Profiles; Airfoils

19970009248 Von Karman Inst. for Fluid Dynamics, Aeronautics/Aerospace Dept., Rhode-Saint-Genese, Belgium

Hypersonic Aerothermodynamics at VKI

Carbonaro, M., Von Karman Inst. for Fluid Dynamics, Belgium; Charbonnier, J.-M., Von Karman Inst. for Fluid Dynamics, Belgium; Deconinck, H., Von Karman Inst. for Fluid Dynamics, Belgium; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 58p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A04, Hardcopy; A04, Microfiche

The Aeronautics/Aerospace Department of the von Karman Institute has been involved in research activities in the hypersonic regime since the 1960's with the installation of the hypersonic free piston tunnel Longshot, which allows to simulate high Reynolds number hypersonic flows. Since then, a Mach 6 blow down facility H3 is also operational and at present time an induction heating facility called Plasmatron is being developed under supervision of the European Space Agency. Simultaneously to the development of experimental techniques, Computational Fluid Dynamics was initiated and in-house made codes are operational to simulate hypersonic flows without chemistry and in thermal equilibrium. The objective of the present paper is to briefly describe the research topics which have been addressed the past years and the current activities at the VKI in the hypersonic aerothermodynamics area. Basic research topics will be first presented and then applications to hypersonic vehicles and development of facilities will be discussed.

Author

Aerothermodynamics; Hypersonics; Research; Computational Fluid Dynamics; Wind Tunnel Tests; Hypersonic Flow

19970009249 Von Karman Inst. for Fluid Dynamics, CFD Group, Rhode-Saint-Genese, Belgium

A Parallel Implicit Multidimensional Upwind Cell Vertex Navier-Stokes Solver for Hypersonic Applications

vanderWeide, E., Von Karman Inst. for Fluid Dynamics, Belgium; Issman, E., Von Karman Inst. for Fluid Dynamics, Belgium; Deconinck, H., Von Karman Inst. for Fluid Dynamics, Belgium; Gegrez, G., Von Karman Inst. for Fluid Dynamics, Belgium; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 12p; In English; Also announced as 19970009247

Contract(s)/Grant(s): ESA-9363/91/NL/FG/CCN2; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

A parallel perfect gas flow solver for axisymmetric applications is described. For the spatial discretization of the convective fluxes it uses a multidimensional upwind, monotonic shock capturing, matrix distribution scheme on a compact stencil (at most the points used by the Galerkin finite element discretization) in an unstructured grid, and the Galerkin finite element method for the viscous part. For fast convergence towards steady state a fully parallel implicit Newton algorithm has been implemented, where the resulting linear systems are solved by subdomain block ILV(0) preconditioned GMRES. A vertex-oriented domain decomposition is used allowing an efficient parallel preconditioner for the GMRES. As the linear systems themselves are solved on the complete grid, the convergence is practically independent of the way the grid is decomposed into subdomains. The message passing library MPI was used for the communication to make the code as portable as possible. Applications are shown for a hypersonic cone-fare configuration at different Mach and Reynolds numbers and a detailed comparison is made with a structured grid

standard Finite Volume solver (the VKI-MB code). Results have been obtained on a four and eight processors SP2 demonstrating the robustness and efficiency of the new flow solver.
Author
Navier-Stokes Equation; Gas Flow; Upwind Schemes (Mathematics); Galerkin Method; Finite Element Method; Unstructured Grids (Mathematics); Computational Fluid Dynamics; Hypersonic Flow; Parallel Flow; Ideal Gas

19970009252 Cranfield Univ., Coll. of Aeronautics, Bedford, UK
Hypersonic Laminar-Turbulent Transition and its Implications for Winged Configurations
Poll, D. I. A., Cranfield Univ., UK; Oct. 1996; 24p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The problem of laminar-turbulent transition on swept back wings travelling at hypersonic speeds has a great practical significance. Swept back wings support three-dimensional boundary layer flows and, in consequence, two mechanisms for transition are admitted which do not occur in two-dimensional situations. These are attachment-line contamination and cross-flow instability. Both these are known to be very important in the generation of turbulent flow in low-speed flows. It is argued that these phenomena are also important in high speed conditions. Available evidence is reviewed and, when possible, estimates are made of the conditions necessary for the transition onset.
Author
Boundary Layer Transition; Hypersonic Flow; Swept Wings; Three Dimensional Boundary Layer; Reynolds Number; Boundary Layer Flow

19970009260 Daimler-Benz Aerospace A.G., Militarflugzeuge, Munich, Germany
The Technology Development and Verification Concept of the German Hypersonics Technology Programme
Hirschel, E. H., Daimler-Benz Aerospace A.G., Germany; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 18p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Within the German Hypersonics Technology Program, a Technology Development and Verification study was performed in order to structure the European Technology Maturation and Verification Phase. Elements of this study are discussed in this contribution. After an introduction to the topic, a classification of hypersonic vehicles is given and the general design process is sketched. The structure of the German Technology and Verification Study is shown, and the reference concept and the major flight parameters are presented. An assessment of aerothermodynamics simulation means ia given along with a consideration of some selected results of sensitivity studies and an explanation of the Transfer Model approach, which was developed in the study. Some remarks on flight testing with experimental vehicles are followed by the summary of the results of the study.
Author
Hypersonics; Hypersonic Vehicles; Aerothermodynamics; Technology Assessment; Computerized Simulation

19970009362 Advisory Group for Aerospace Research and Development, Fluid Dynamics Panel, Neuilly-Sur-Seine, France
Cooperative Programme on Dynamic Wind Tunnel Experiments for Manoeuvring Aircraft ***Programme en cooperation sur l experimentation dynamique en soufflerie pour la manoeuvrabilite de l avion***
Oct. 1996; 250p; In English
Report No.(s): AGARD- AR-305; ISBN-92-836-1043-1; Copyright Waived; Avail: CASI; A11, Hardcopy; A03, Microfiche

This report describes a multinational cooperative program set up by the AGARD Fluid Dynamics Panel in response to the continuing interest among the NATO countries in dynamic wind tunnel testing. Such testing is essential for obtaining the aerodynamic information required to predict the behavior of an aircraft performing angular motions. At low angles of attack this occurs primarily when the aircraft performs a small-amplitude oscillatory motion resulting from a disturbance or a control deflection. The dynamic stability can then be predicted by solving linear equations of motion in which the aerodynamic reactions are represented by the so called stability derivatives, obtainable from oscillatory experiments. At high angles of attack this occurs when the aircraft is involved in a spin, in which case rotary-balance data are required, or performs a rapid maneuver, in which case both rotary-balance and large amplitude oscillatory data are needed. Such data are often non-linear and time dependent, compounding the complexity of the prediction and analysis.
Derived from text
Aircraft Maneuvers; Flight Characteristics; Angle of Attack; Angular Velocity; Dynamic Tests; Equations of Motion; Linear Equations; Stability Derivatives

03
AIR TRANSPORTATION AND SAFETY

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

19970009366 Allied-Signal Aerospace Co., Phoenix, AZ USA
Quiet High-Speed Fan ***Final Report***
Lieber, Lysbeth, Allied-Signal Aerospace Co., USA; Repp, Russ, Allied-Signal Aerospace Co., USA; Weir, Donald S., Allied-Signal Aerospace Co., USA; Nov. 1996; 96p; In English
Contract(s)/Grant(s): NAS3-27483; RTOP 538-03-11
Report No.(s): NASA-CR-198518; NAS 1.26:198518; E-10398; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A calibration of the acoustic and aerodynamic prediction methods was performed and a baseline fan definition was established and evaluated to support the quiet high speed fan program. A computational fluid dynamic analysis of the NASA QF-12 Fan rotor, using the DAWES flow simulation program was performed to demonstrate and verify the causes of the relatively poor aerodynamic performance observed during the fan test. In addition, the rotor flowfield characteristics were qualitatively compared to the acoustic measurements to identify the key acoustic characteristics of the flow. The V072 turbofan source noise prediction code was used to generate noise predictions for the TFE731-60 fan at three operating conditions and compared to experimental data. V072 results were also used in the Acoustic Radiation Code to generate far field noise for the TFE731-60 nacelle at three speed points for the blade passage tone. A full 3-D viscous flow simulation of the current production TFE731-60 fan rotor was performed with the DAWES flow analysis program. The DAWES analysis was used to estimate the onset of multiple pure tone noise, based on predictions of inlet shock position as a function of the rotor tip speed. Finally, the TFE731-60 fan rotor wake structure predicted by the DAWES program was used to define a redesigned stator with the leading edge configured to minimize the acoustic effects of rotor wake / stator interaction, without appreciably degrading performance.
Author
Turbofans; Aeroacoustics; Noise Prediction; Engine Noise; Noise Reduction

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970005613 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA USA
An Interactive Software for Conceptual Wing Flutter Analysis and Parametric Study
Mukhopadhyay, Vivek, National Aeronautics and Space Administration. Langley Research Center, USA; Aug. 1996; 20p
Contract(s)/Grant(s): RTOP 505-69-59-04
Report No.(s): NASA-TM-110276; NAS 1.15:110276; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An interactive computer program was developed for wing flutter analysis in the conceptual design stage. The objective was to estimate the flutter instability boundary of a flexible cantilever wing, when well-defined structural and aerodynamic data are not available, and then study the effect of change in Mach number, dynamic pressure, torsional frequency, sweep, mass ratio, aspect ratio, taper ratio, center of gravity, and pitch inertia, to guide the development of the concept. The software was developed for Macintosh or IBM compatible personal computers, on MathCad application software with integrated documentation, graphics, data base and symbolic mathematics. The analysis method was based on non-dimensional parametric plots of two primary flutter parameters, namely Regier number and Flutter number, with normalization factors based on torsional stiffness, sweep, mass ratio, taper ratio, aspect ratio, center of gravity location and pitch inertia radius of gyration. The parametric plots were compiled in a Vought Corporation report from a vast data base of past experiments and wind-tunnel tests. The computer program was utilized for flutter analysis of the outer wing of a Blended-Wing-Body concept, proposed by McDonnell Douglas Corp. Using a set of assumed data, preliminary flutter boundary and flutter dynamic pressure variation with altitude, Mach number and torsional stiffness were determined.
Author
Software Development Tools; Software Engineering; Applications Programs (Computers); Computer Programs; Data Bases; Flutter Analysis; Wind Tunnel Tests; Mach Number; Mass Ratios; Flexible Wings; Aerodynamics

19970008122 NASA Lewis Research Center, Cleveland, OH USA

Effect of In-Flight Ice Accretion on the Performance of a Multi-Element Airfoil

Khodadoust, Abdollah, McDonnell-Douglas Aerospace, USA; Dominik, Chet, McDonnell-Douglas Aerospace, USA; Shin, Jaiwon, NASA Lewis Research Center, USA; Miller, Dean, NASA Lewis Research Center, USA; 1995; 10p; In English; International Icing Symposium, 18-21 Sep. 1995, Montreal, Canada; Sponsored by Society of Automotive Engineers, Inc., USA

Contract(s)/Grant(s): RTOP 505-68-10

Report No.(s): NASA-TM-112174; NAS 1.15:112174; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The effects of potential in-flight ice accretion on the aerodynamic performance of a multi-element high-lift airfoil have been investigated at moderate-to-high Reynolds numbers. The investigation was conducted in the Low Turbulence Pressure Tunnel (LTPT) at NASA Langley Research Center. Simulated ice shapes obtained from earlier testing in the Icing Research Tunnel (IRT) at NASA Lewis Research Center were used on all three elements of the multi-element configuration. Incremental performance effects due to the ice accretion are presented for both smooth and rough ice accretions. Reynolds number effects on the measured performance characteristics were also assessed. The present results confirm the importance of avoiding any ice accretions on the forward element of a lifting configuration.

Author

Airfoils; Aircraft Icing; Reynolds Number; Wind Tunnel Tests; Angle of Attack; Lift

19970008131 National Aerospace Lab., Tokyo, Japan

Simulation Study for a Fire Helicopter, Part 2, Effects of Turbulent Wind on theEfficiency and Safety

Okuno, Yoshinori, National Aerospace Lab., Japan; Funabiki, Kohei, National Aerospace Lab., Japan; Harada, Masashi, National Aerospace Lab., Japan; Jun. 1996; ISSN 0389-4010; 21p; In Japanese; Original contains color illustrations

Report No.(s): NAL-TR-1293; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Simulation tests of a fire helicopter are performed using a flight simulator. A fire helicopter, which has the capability to suppress a fire in high-rise buildings by discharging pressurized water while hovering near the fire, is being developed by the Tokyo Fire Department. One of the problems in realizing this concept is the heavily turbulent wind around buildings that may cause difficulties in maintaining a stable hover. Wind tunnel tests and theoretical calculations are performed to clarify the characteristics of the turbulence. Based on these results, some wind models around a high-rise building are developed, which are available in real time flight simulations. Extensive piloted simulations are carried out using these models, demonstrating that the fire helicopter can suppress fires efficiently up to a wind speed of 7 m/s. Safety criteria are also proposed for the situation when the helicopter approaches a building. The results proved the effectiveness and safety of the fire helicopter. As a result, the approval was granted for the experimental operation in March 1996.

Author

Helicopters; Fire Fighting; Computerized Simulation; Flight Simulators; Wind Effects

19970008141 National Aerospace Lab., Tokyo, Japan

A Conceptual Study of An Advanced VTOL Transport Aircraft

Saito, Yoshio, National Aerospace Lab., Japan; Endoh, Masanori, National Aerospace Lab., Japan; Matsuda, Yukio, National Aerospace Lab., Japan; Sugiyama, Nanahisa, National Aerospace Lab., Japan; Watanabe, Minoru, National Aerospace Lab., Japan; Sugahari, Noboru, National Aerospace Lab., Japan; Yamamoto, Kazumoi, National Aerospace Lab., Japan; May 1996; ISSN 0389-4010; 16p; In Japanese

Report No.(s): NAL-TR-1292; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A new concept of an advanced VTOL transport aircraft is studied and presented. The 100-passenger all-composite aircraft, with separated core type lift fan engines and cruise fan engines, has a highly optimized configuration for high subsonic flight. It is estimated that the aircraft is much quieter than conventional transports or small helicopters, and that the VTOL transport aircraft does not seem to present technical problems that could not otherwise be solved.

Author

Vertical Takeoff Aircraft; Transport Aircraft; Subsonic Speed; Aircraft Configurations; Passenger Aircraft

19970009256 NASA Lewis Research Center, Cleveland, OH USA

Computational Modeling and Validation for Hypersonic Inlets

Povinelli, Louis A., NASA Lewis Research Center, USA; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 10p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Hypersonic inlet research activity at NASA is reviewed. The basis for the paper is the experimental tests performed with three inlets: the NASA Lewis Research Center Mach 5, the McDonnell Douglas Mach 12, and the NASA Langley Mach 18. Both three-dimensional PNS and NS codes have been used to compute the flow within the three inlets. Modeling assumptions in the codes involve the turbulence model, the nature of the boundary layer, shock wave-boundary layer interaction, and the flow spilled to the outside of the inlet. Use of the codes and the experimental data are helping to develop a clearer understanding of the inlet flow physics and to focus on the modeling improvements required in order to arrive at validated codes.
Author
Hypersonic Inlets; Mach Number; Inlet Flow; Flow Distribution; Turbulence Models; Shock Wave Interaction; Pressure Distribution; Computational Fluid Dynamics

19970009376 Georgia Inst. of Tech., Aerospace Systems Design Lab., Atlanta, GA USA
Tailored Cost Model for Military Aircraft ***Topical Report, 24 Sep. 1996***
Dec. 13, 1996; 18p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Tailored Cost Model (TCM) software was developed at McDonnell Douglas. It uses standard Lotus spreadsheets to perform a detailed economic analysis (Life Cycle Cost) of a military aircraft system. The cost calculations are based on Cost Estimating Relationships (CERs) derived from large historical databases or selected from public domain models (3, 4, 5, 6, 7). Parts weights and complexities act as main drivers. The depth of analysis led to a huge amount of equation cells. Given the personal computing technology of the early 1990's, this bulk of data could only be handled by distributing it over several individual spreadsheet files. This made the process of analyzing an aircraft system quite cumbersome, as every file had to be manually loaded, then processed and saved, and its data combined with the subsequent file.
Derived from text
Design to Cost; Military Aircraft; Cost Analysis; Life Cycle Costs; Economic Analysis; Aircraft Models

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19970007618 NASA Lewis Research Center, Cleveland, OH USA
Low Gravity Guidance System for Airborne Microgravity Research
Rieke, W. J., NASA Lewis Research Center, USA; Emery, E. F., NASA Lewis Research Center, USA; Boyer, E. O., NASA Lewis Research Center, USA; Hegedus, C., NYMA, Inc., USA; ODonoghue, D. P., NYMA, Inc., USA; Nov. 1996; 12p; In English; 34th; Aerospace Sciences Meeting and Exhibit, 15-18 Jan. 1996, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS3-27186; RTOP 963-80-0E
Report No.(s): NASA-TM-107139; E-10069; NAS 1.15:107139; AIAA Paper 96-0936; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Microgravity research techniques have been established to achieve a greater understanding of the role of gravity in the fundamentals of a variety of physical phenomena and material processing. One technique in use at the NASA Lewis Research Center involves flying Keplarian trajectories with a modified Lear Jet and DC-9 aircraft to achieve a highly accurate Microgravity environment by neutralizing accelerations in all three axis of the aircraft. The Low Gravity Guidance System (LGGS) assists the pilot and copilot in flying the trajectories by displaying the aircraft acceleration data in a graphical display format. The Low Gravity Guidance System is a microprocessor based system that acquires and displays the aircraft acceleration information. This information is presented using an electroluminescent display mounted over the pilot's instrument panel. The pilot can select the Microgravity range that is required for a given research event. This paper describes the characteristics, design, calibration and testing of the Low Gravity Guidance System Phase 3, significant lessons from earlier systems and the developmental work on future systems.
Author
Microgravity; Display Devices; Weightlessness Simulation; Aircraft Guidance; Aircraft Instruments; Indicating Instruments

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.

19970007724 Prins Maurits Lab. TNO, Rijswijk, Netherlands
Developments in Missile Ramjet Propulsion ***Final Report***
Calzone, R. F., Prins Maurits Lab. TNO, Netherlands; Dec.1996; 77p; In English
Contract(s)/Grant(s): A95/KLu/487; Proj. 2234-96-300
Report No.(s): TD96-0427; PML-1996-A100; Copyright; Avail: Issuing Activity (TNO Prins Maurits Lab., Rijswijk, Netherlands), Hardcopy, Microfiche

At the request of the Royal Netherlands Air Force, a study into the international developments on missile ramjet propulsion has been carried out. It is the objective of this work to provide an outline of ramjet propulsion for missiles with a view on technical and operational aspects as well as the ongoing international developments. he essential areas for employment of missile systems, which are presently insufficiently perceived for ramjet issile systems, have been identified in accordance with the Royal Netherlands Air Force. Future work on these areas will be defined in consensus with the Royal Netherlands Air Force.
Author (revised)
Propulsion; Ramjet Engines; Missile Systems

19970008377 Technische Hogeschool, Aerospace Engineering, Delft, Netherlands
A Review of Propeller Modelling Techniques Based on Euler Methods
Zondervan, G. J. D., Technische Hogeschool, Netherlands; Nov. 1995; 81p; In English
Report No.(s): LR-797; ISBN-90-5623-031-X; Copyright; Avail: Issuing Activity (Delft Univ. of Technology, PO Box 5058, 2600 GB Delft, The Netherlands), Hardcopy, Microfiche

New, advanced design tools like Euler methods will be needed in the design process of future civil aircraft powered by new, highly efficient propeller propulsion systems. This report describes the application of Euler methods to the modelling of propeller generated flowfields. The general layout of propellers is introduced along with the propeller slipstream. It is argued that Euler methods can treat a wider range of flow conditions than classical propeller theories. The power of Euler methods lies in the fact a separate wake model is not needed because their solution includes the propeller slipstream. Two different ways are described for modeling the propeller slipstream using Euler methods. These are the time-accurate approach that uses the real propeller geometry and the time-averaged approach using an actuator disc representation of the propeller.
Derived from text
Boundary Conditions; Propeller Slipstreams; Propulsion System Configurations; Flow Distribution; Computer Aided Design; Computational Grids; Euler Equations of Motion

19970009254 Daimler-Benz Aerospace A.G., Military Aircraft, Munich, Germany
Inlet and Propulsion Integration of RAM Propelled Vehicles
Bissinger, N. C., Daimler-Benz Aerospace A.G., Germany; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 46p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The design of intakes and afterbodies for hypersonic vehicles with RAM air breathing propulsion systems is described. The aerodynamic aspects of the integration of the forebody with the intake and the afterbody with the nozzle are outlined. The potentials and deficits of modern available tools are demonstrated and a strategy for the design of the propulsion system for a hypersonic vehicle is proposed.
Author
Propulsion System Configurations; Afterbodies; Air Intakes; Ramjet Engines; Computational Fluid Dynamics; Flow Visualization; Navier-Stokes Equation; Wind Tunnel Tests

19970009255 NASA Lewis Research Center, Cleveland, OH USA
Inlet and Propulsion Integration of Scram Propelled Vehicles
Povinelli, Louis A., NASA Lewis Research Center, USA; Oct. 1996; 22p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The material to be presented in these two lectures begins with cycle considerations of the turbojet engine combined with a ramjet engine to provide thrust over the range of Mach 0 to 5. We will then examine in some detail the aerodynamic behavior that

occurs in the inlet operating near the peak speed. Following that, we shall view a numerical simulation through a baseline scramjet engine, starting at the entrance to the inlet, proceeding into the combustor and through the nozzle. In the next segment, we examine a combined rocket and ramjet propulsion system. Analysis and test results will be examined with a view toward evaluation of the concept as a practical device. Two other inlets will then be reviewed: a Mach 12 inlet and a Mach 18 configuration. Finally, we close our lectures with a discussion of the Detonation Wave engine, and inspect the physical and chemical behavior obtained from numerical simulation. A few final remarks will be made regarding the application of CFD for hypersonic propulsion components.
Author
Systems Integration; Turbojet Engines; Mach Number; Air Intakes; Hypersonic Speed; Computerized Simulation; Supersonic Combustion Ramjet Engines; Propulsion System Performance

08
AIRCRAFT STABILITY AND CONTROL

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

19970005615 Arnold Engineering Development Center, Arnold AFS, TN USA
Equations for Store Separation Motion Simulations and Instrumented Model Data Reduction ***Final Report, Oct. 1993 - Jan. 1995***
Keen, K. S., Arnold Engineering Development Center, USA; Aug. 1996; 231p; In English
Contract(s)/Grant(s): AF Proj. 0675
Report No.(s): AD-A313396; AEDC-TR-95-12; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The mathematical equations of motion for ground simulation of the separation trajectories of stores from aircraft are developed in this document. The equations have application to both analytical and wind tunnel captive trajectory store separation testing. The equations of motion as presented here include features not previously available in AEDC analytical and wind tunnel simulations such as arbitrary aircraft maneuvers, more rigorous models of the specific pivot hardware used by some aircraft, and downrail motions with all components of kinematic acceleration (including Corlolis effects) modeled. The data reduction equations for free-falling instrumented store models are also included.
DTIC
Aircraft Maneuvers; Data Reduction; Motion Simulation; Equations of Motion; Wind Tunnel Tests

19970007200 NASA Langley Research Center, Hampton, VA USA
Nonlinear Stability of Supersonic Jets
Bhat, T. R. S., Old Dominion Univ., USA; Seiner, J. M., NASA Langley Research Center, USA; Tiwari, S. N., Old Dominion Univ., USA; 1995; 10p; In English; 1st; Aeroacoustics, 12-15 Jun. 1995, Munich, Germany; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAG1-1518
Report No.(s): NASA-TM-111928; NAS 1.15:111928; AIAA Paper 95-089; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper presents stability calculations made for a shock-free supersonic jet using the model based on parabolized stability equations. In this analysis the large-scale structures, which play a dominant role in the mixing as well as the noise radiated, are modeled as instability waves. This model takes into consideration non-parallel flow effects and also nonlinear interaction of the instability waves. The stability calculations have been performed for different frequencies and mode numbers over a range of jet operating temperatures. Comparisons are made, where appropriate, with the solutions to Rayleigh's equation (linear, inviscid analysis with the assumption of parallel flow). The comparison of the solutions obtained using the two approaches show very good agreement.
Author
Supersonic Jet Flow; Rayleigh Equations; Noise Reduction; Jet Aircraft Noise; Supersonic Commercial Air Transport

19970007336 Georgia Inst. of Tech., Atlanta, GA USA
Research In Nonlinear Flight Control for Tiltrotor Aircraft Operating in the Terminal Area ***Progress Report No. 1, 1 Sep. 1995 - 31 Aug. 1996***
Calise, A. J., Georgia Inst. of Tech., USA; Rysdyk, R., Georgia Inst. of Tech., USA; Nov. 1996; 43p; In English
Contract(s)/Grant(s): NCC2-922
Report No.(s): NASA-CR-203112; NAS 1.26:203112; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The research during the first year of the effort focused on the implementation of the recently developed combination of neural net work adaptive control and feedback linearization. At the core of this research is the comprehensive simulation code Generic Tiltrotor Simulator (GTRS) of the XV-15 tilt rotor aircraft. For this research the GTRS code has been ported to a Fortran environment for use on PC. The emphasis of the research is on terminal area approach procedures, including conversion from aircraft to helicopter configuration. This report focuses on the longitudinal control which is the more challenging case for augmentation. Therefore, an attitude command attitude hold (ACAH) control augmentation is considered which is typically used for the pitch channel during approach procedures. to evaluate the performance of the neural network adaptive control architecture it was necessary to develop a set of low order pilot models capable of performing such tasks as, follow desired altitude profiles, follow desired speed profiles, operate on both sides of powercurve, convert, including flaps as well as mastangle changes, operate with different stability and control augmentation system (SCAS) modes. The pilot models are divided in two sets, one for the backside of the powercurve and one for the frontside. These two sets are linearly blended with speed. The mastangle is also scheduled with speed. Different aspects of the proposed architecture for the neural network (NNW) augmented model inversion were also demonstrated. The demonstration involved implementation of a NNW architecture using linearized models from GTRS, including rotor states, to represent the XV-15 at various operating points. The dynamics used for the model inversion were based on the XV-15 operating at 30 Kts, with residualized rotor dynamics, and not including cross coupling between translational and rotational states. The neural network demonstrated ACAH control under various circumstances. Future efforts will include the implementation into the Fortran environment of GTRS, including pilot modeling and NNW augmentation for the lateral channels. These efforts should lead to the development of architectures that will provide for fully automated approach, using similar strategies.
Derived from text
Tilt Rotor Aircraft; Rotor Dynamics; Helicopters; Attitude Control; Adaptive Control; Feedback Control; Linearization; Stability; XV-15 Aircraft

19970008007 Institute for Human Factors TNO, Soesterberg, Netherlands
Development and Performance of a Cockpit Control System Operated by Voice: Summary Report of Project DMKLu/AC02/A/9105 ***Final Report Ontwikkeling en prestatie van een door spraak bediend cockpit-besturingssyssysteem; samenvattigsrapportage van fase 3 van het project DMKLu/AC02/A/9105***
Steeneken, H. J. M., Institute for Human Factors TNO, Netherlands; Nov. 29, 1996; 15p; In English
Contract(s)/Grant(s): A91/KLu/325
Report No.(s): RP-96-0198; TNO-TM-96-A055; Copyright; Avail: Issuing Activity (TNO Human Factors Research Institute, Kampweg 5, PO Box 23, 3769 ZG Soesterberg, The Netherlands), Hardcopy, Microfiche
This report is an overview of the development and flight testing os a cockpit voice control system for an F-16 aircraft. The Royal Netherlands Air Force pilots flew 17 of the 29 sessions flown. The overall achieved accuracy of word recognition was about 69 percent with scores per session ranging from 0.53 to 0.88. The average completion rate (i.e., correctly executed commands) was around 66 percent. This low performance is insufficient for the envisioned operational applications. During the pilot debriefing, it was learned that although performance was considered insufficient, the expansion of functions, such as radio station selection by name, was highly appreciated. In general, the syntax used was too complex and this lead to incorrect commands. A more flexible command language is required. A data base was compiled with the recorded speech signals from the 17 sorties. With this data base, repetitive experiments can be carried out with different types of recognizers. The assessment of a new large vocabulary speech recognizer that was trained for the grammar (command string construction) of the cockpit commands produced a significantly higher recognition performance of 87 percent.
Derived from text
Command Languages; Voice Control; Words (Language); Flight Tests; Speech Recognition; Voice Communication; Command and Control

19970008392 NASA Langley Research Center, Hampton, VA USA
Lateral-Directional Eigenvector Flying Qualities Guidelines for High Performance Aircraft
Davidson, John B., NASA Langley Research Center, USA; Andrisani, Dominick, II, Purdue Univ., USA; Dec. 1996; 60p; In English
Contract(s)/Grant(s): RTOP 522-22-21-03
Report No.(s): NASA-TM-110306; NAS 1.15:110306; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
This report presents the development of lateral-directional flying qualities guidelines with application to eigenspace (eigenstructure) assignment methods. These guidelines will assist designers in choosing eigenvectors to achieve desired closed-loop flying qualities or performing trade-offs between flying qualities and other important design requirements, such as achieving realizable gain magnitudes or desired system robustness. This has been accomplished by developing relationships between the sys-

tem's eigenvectors and the roll rate and sideslip transfer functions. Using these relationships, along with constraints imposed by system dynamics, key eigenvector elements are identified and guidelines for choosing values of these elements to yield desirable flying qualities have been developed. Two guidelines are developed - one for low roll-to-sideslip ratio and one for moderate-to-high roll-to-sideslip ratio. These flying qualities guidelines are based upon the Military Standard lateral-directional coupling criteria for high performance aircraft - the roll rate oscillation criteria and the sideslip excursion criteria. Example guidelines are generated for a moderate-to-large, an intermediate, and low value of roll-to-sideslip ratio.
Author
Eigenvectors; Fighter Aircraft; Supersonic Aircraft; Flight Characteristics; Lateral Stability

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.

19970008138 Army Cold Regions Research and Engineering Lab., Hanover, NH USA
PCC Airfield Pavement Response During Thaw-Weakening Periods. A Field Study
Janoo, Vincent C., Army Cold Regions Research and Engineering Lab., USA; Berg, Richard L., Army Cold Regions Research and Engineering Lab., USA; May 1996; 46p; In English
Contract(s)/Grant(s): 4A762784AT42
Report No.(s): AD-A310423; CRREL-SR-96-12; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This investigation is part of CRREUs on-going characterization of pavement performance in seasonal frost areas. As part of the research, CRREL conducted several field studies for the Federal Aviation Administration (FM) on the response of airport pavements during thaw-weakening periods at three civil airports in Wisconsin, where the design freezing index in the area was around 900 to 1100 C-days and frost penetration ranged between 1250 to 2000 mm. This study focused on the performance of Portland Cement Concrete (PCC) pavements during the spring thaw-weakening period. The sites were instrumented with subsurface thermocouples and Falling Weight Deflectometer (FWD) tests were conducted during the spring thaw period at the center of the slab and across the joints. An analysis of the FWD data and backcalculation of the layer moduli using ILLIBACK and WESDEF was conducted. Unique relationships between the FWD deflections and the subgrade modulus and coefficient of subgrade reaction were obtained. Additional relationships were developed using the FWD deflections, PCC thickness and the horizontal tensile stress at the bottom of the PCC layer. A relationship between load transfer across joints and FWD deflections was also developed. On the basis of the relationships obtained in this study, a methodology for evaluating PCC pavements during s pring thaw was developed. However, this methodology needs to be verified for other subgrade types and areas with other design freezing indices.
DTIC
Pavements; Frost; Cements; Tensile Stress; Loads (Forces); Freezing; Airports

19970009349 NASA Lewis Research Center, Cleveland, OH USA
An Experimental Device for Generating High Frequency Perturbations in Supersonic Wind Tunnels
Melcher, Kevin J., NASA Lewis Research Center, USA; Ibrahim, Mounir B., Cleveland State Univ., USA; Dec. 1996; 16p; In English; International Congress on Fluid Dynamics and Propulsion, 29-31 Dec. 1996, Cairo, Egypt; Sponsored by Cairo Univ., Egypt
Contract(s)/Grant(s): RTOP 537-05-21
Report No.(s): NASA-TM-107385; NAS 1.15:107385; E-10578; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This paper describes the analytical study of a device that has been proposed as a mechanism for generating gust-like perturbations in supersonic wind tunnels. The device is envisioned as a means to experimentally validate dynamic models and control systems designed for high-speed inlets. The proposed gust generator is composed of two flat trapezoidal plates that modify the properties of the flow ingested by the inlet. One plate may be oscillated to generate small perturbations in the flow. The other plate is held stationary to maintain a constant angle-of-attack. Using an idealized approach, design equations and performance maps for the new device were developed from the compressible flow relations. A two-dimensional CFD code was used to confirm the correctness of these results. The idealized approach was then used to design and evaluate a new gust generator for a 3.05-meter by 3.05-meter (10-foot by 10-foot) supersonic wind tunnel.
Author
Supersonic Wind Tunnels; Gusts; Inlet Flow; Wind Tunnel Apparatus; Surges; Pressure Pulses

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.

19970005629 Northrop Grumman Corp., Bethpage, NY USA
Novel Composites for Wing and Fuselage Applications ***Final Report, Jun. 1992 - Sep. 1994***
Suarez, J. A., Northrop Grumman Corp., USA; Buttitta, C., Northrop Grumman Corp., USA; Sep. 1996; 90p; In English
Contract(s)/Grant(s): NAS1-18784; RTOP 538-10-11-02
Report No.(s): NASA-CR-201612; NAS 1.26:201612; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Design development was successfully completed for textile preforms with continuous cross-stiffened epoxy panels with cutouts. The preforms developed included 3-D angle interlock weaving of graphite structural fibers impregnated by resin film infiltration (RFI) and shown to be structurally suitable under conditions requiring minimum acquisition costs. Design guidelines/analysis methodology for such textile structures are given. The development was expanded to a fuselage side-panel component of a subsonic commercial airframe and found to be readily scalable. The successfully manufactured panel was delivered to NASA Langley for biaxial testing. This report covers the work performed under Task 3 -- Cross-Stiffened Subcomponent; Task 4 -- Design Guidelines/Analysis of Textile-Reinforced Composites; and Task 5 -- Integrally Woven Fuselage Panel.
Author
Resin Matrix Composites; Preforms; Woven Composites; Fabrication; Fuselages; Wings; Airframe Materials; Composite Structures

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.

19970005620 Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA
Active Control of Combustion Instability in a Ramjet Using Large-Eddy Simulations ***Final Report, 1 Sep. 1992 - 31 Jul. 1995***
Menon, Suresh, Georgia Inst. of Tech., USA; Jul. 1995; 157p; In English
Contract(s)/Grant(s): N00014-92-J-4030
Report No.(s): AD-A317107; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This study has developed a large-eddy simulation model for active control. The basic simulation co ntrol was extended for general applications, the simulation code was implemented on a massively parallel processor, and two active control techniques (acoustic feedback control and secondary fuel injection control) were investigated. However, the primary focus for active control in this study was on secondary fuel injection techniques, as it had been demonstrated in past experimental studies that this method was more practical. Numerical simulations of fuel injection control were carried out and, in addition, a theoretical model for secondary fuel injection control was developed along with a method to couple the theoretical model to the simulation model. Finally, to implement a robust controller, a fuzzy logic based controller for fuel injection was studied using a simplified problem geometry. to investigate the effects of three-dimensionality, full 3D Large-Eddy Simulation (LES) of combustion instability was also carried out.
DTIC
Combustion Stability; Eddy Currents; Ramjet Engines; Computerized Simulation

19970007214 Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Human Factors Research Inst., Soesterberg, Netherlands
Automatic Speech Recognition Performance in a Simulation-Based Fast-Jet Cockpit Application ***Interim Report Automatische spraakherkenning toegepast voor controletaken in de cockpit van een jachtvliegtuig***
Steeneken, H. J. M., Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Netherlands; Kriekaard, J. J., Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Netherlands; vanLeeuwen, D. A., Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Netherlands; Nov. 28, 1996; 17p; In English
Contract(s)/Grant(s): A91/Klu/325

Report No.(s): TNO-TM-96-A053; RP-96-0196; Copyright; Avail: Issuing Activity (Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Soesterberg, Netherlands), Hardcopy, Microfiche

A project on automatic speech recognition for control of systems in a fastjet cockpit was conducted by the TNO Human Factors Research Institute (TNO-HFRI) and the National Aerospace Laboratory (NLR). The project included three phases: (1) the feasibility, (2) speech recognizer selection and implementation in a flight simulator and (3) performance testing in an advanced fast jet simulator. Presently the experiments for phase 3 were conducted, the results are given in this report. The experiments consisted of over 29 sorties of approximately one hour each. In total the results of 17 sorties, performed by three experienced pilots, were analyzed. During each sortie a pilot in the F-16 National Simulator Facility had access to a control by voice of radio systems, displays and Hands-On-Throttle-And-Stick (HOTAS) functions. These systems could also be controlled manually as in the normal situation. During the 'flight' tests recordings were made of the speech signals and a video recording of the pilot actions. Analysis of all pilot actions including the voice control and debriefing was performed by the NLR and is reported separately. In this report the recognizer performance is analyzed. It was found that under these simulator flight conditions the performance (accuracy) drops from over 0.95 for read speech to 0.69 for the simulator spontaneous speech condition. Results obtained in four flight experiments performed in other laboratories showed similar results for read speech (three experiments) and for spontaneous speech (one experiment). From the original 281 word vocabulary only 65 words were used frequently by the pilots. These 65 words had a coverage of 90% of all words used during the tests. This means that the complexity of the recognition process can be reduced which will lead to a better performance of the recognizer. From the speech material a calibrated date base was built with all the speech utterances annotated orthographically at command string level. This data base is described in a separate report. A pilot study was performed with a modern phoneme/grammar based recognizer. With this speaker independent system a mean performance of 0.85 (accuracy) was obtained.

Derived from text

Speech Recognition; Voice Control; Cockpits; Automatic Control; Feasibility; Words (Language)

19970007979 NASA Lewis Research Center, Cleveland, OH USA

Predicted Turbine Heat Transfer for a Range of Test Conditions

Boyle, R. J., NASA Lewis Research Center, USA; Lucci, B. L., NASA Lewis Research Center, USA; Nov. 1996; 42p; 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): RTOP 505-62-52

Report No.(s): NASA-TM-107374; NAS 1.15:107374; E-10543; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Comparisons are shown between predictions and experimental data for blade and endwall heat transfer. The comparisons of computational domain parisons are given for both vane and rotor geometries over an extensive range of Reynolds and Mach numbers. Comparisons are made with experimental data from a variety of sources. A number of turbulence models are available for predicting blade surface heat transfer, as well as aerodynamic performance. The results of an investigation to determine the turbulence model which gives the best agreement with experimental data over a wide range of test conditions are presented.

Author

Aerodynamic Characteristics; Heat Transfer; Turbulence Models; Turbine Blades; Wall Flow; Navier-Stokes Equation

19970007989 Rockwell International Corp., Science Center, ThoUSAnd Oaks, CA USA

Development of Combined Asymptotic and Numerical Procedures for Transonic and Hypersonic Flows ***Final Report, 1 Nov. 1991 - 31 Dec. 1995***

Malmuth, N., Rockwell International Corp., USA; Fedorov, A., Rockwell International Corp., USA; Khokhlov, A., Rockwell International Corp., USA; Cole, J., Rockwell International Corp., USA; Apr. 1996; 142p; In English; Original contains color plates

Contract(s)/Grant(s): F49620-92-C-0006

Report No.(s): AD-A310408; SC71062.FTR; AFOSR-TR-96-0321; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Hypersonic and transonic flows of practical interest were investigated using combined asymptotic and numerical methods. In the hypersonic regime, strong, moderate and weak interaction between shock and boundary layers were emphasized in relation to stability and transition. A new instability was identified in which disturbances reflect from the boundary layer edge of a waveguide formed by the boundary layer and a flat plate. Other new amplification phenomena were discovered related to three-dimensional disturbances and finite amplitude fluctuations in thin Newtonian shock layers. It was shown that the latter can produce inflectional instabilities that can be exploited to enhance mixing in scramjet combustors. Similitudes were used to collapse Reentry-F cone data to a universal curve, forming a basis for quick-response hypersonic transition prediction. Another theoretical analysis showed that ultrasonically absorptive thermal protection surfaces can damp inviscid second-mode acoustic instabilities with

the possibility of transition control. In the transonic speed range, an area rule for wall interference was developed as well as asymptotic theories for lifting interference and the effect of non circular walls. These provide systematic approximation procedures for quick correction methods and optimal model sizing for maximum unit Reynolds number and minimum wall interference.
DTIC
Transonic Flow; Hypersonic Flow; Computational Fluid Dynamics; Boundary Layer Transition; Boundary Value Problems; Unsteady Flow; Asymptotic Methods; Aerodynamic Interference; Inviscid Flow; Shock Waves; Wall Flow

19970008625
Experimental studies of magnetic levitation train aerodynamics
Tyll, J. S., Virginia Polytechnic Inst and State Univ, USA; Liu, D.; Schetz, J. A.; Marchman, J. F.; AIAA Journal; December 1996; ISSN 0001-1452; 34, 12, pp. 2465-2470; In English; Copyright; Avail: Issuing Activity

A high-speed moving-track test system was designed and built for the aerodynamic testing of magnetically levitated vehicle (Maglev) models. The moving-track test system was configured to match wind speeds up to 150 miles per hour and to extend a sufficient distance upstream and downstream of the test-vehicle model to provide a uniform flowfield at the model nose and to simulate proper closure of the flowfield at the rear of the model. Extensive flowfield testing around the track system confirmed its capability to properly simulate the flow around the high-speed tracked vehicle. The selected Maglev model was tested with the moving-track system, and aerodynamic forces and moments were measured. Hot-wire anemometer surveys were used to examine the flowfield behind the model and the turbulence levels and transition location on the vehicle nose. Flow visualization tests were also conducted to verify the nature of the flowfield found in the velocity surveys. Testing included direct measurement of skin friction at selected locations on the model. Separate tests were conducted with the track system removed from the tunnel. The resulting data provide a database for use in the design of Maglev systems and for comparison with computer analyses.
Author (EI)
Aerodynamics; Anemometers; Flow Visualization; High Speed; Magnetic Levitation Vehicles; Tracked Vehicles; Traction; Turbulence

19970009251 Calspan-Buffalo Univ. Research Center, Physics and Chemistry Sciences Dept., NY USA
Viscous/Inviscid and Real-Gas Effects Associated with Hypersonic Vehicles
Holden, Michael S., Calspan-Buffalo Univ. Research Center, USA; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 82p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A05, Hardcopy; A04, Microfiche

In this segment of the lecture series, we discussed some of the important effects of viscous/inviscid interaction and real gas phenomena on the design and performance of hypersonic vehicles. Following a general review of the importance of such effects on vehicle design and performance, we discuss the effects of non-equilibrium and real-gas flows with emphasis on their importance to the accurate simulation of hypervelocity flows in ground test facilities. Because boundary layer transition exerts a dominant influence on vehicle performance in a hypersonic flow regime, we briefly review some of the key phenomena which control boundary layer transition in regions of adverse pressure gradient crossflow and along the attachment line of swept leading edges. For it is such phenomena, where it is currently believed that experimental measurements in hypersonic ground test facilities are of relevance. The key phenomena associated with shockwave/boundary layer interaction for both laminar and turbulent, two- and three-dimensional flows are briefly reviewed and compared with the most recent prediction techniques. The aerothermal loads and flowfield phenomena associated with regions of shock/shock interaction are then discussed with particular emphasis on the effects of boundary layer transition and low-density flows on the magnitude of the peak heating in regions of Type 3 and 4 interactions. Film and transpiration cooling must be employed to cool the internal components of high performance scramjet engines. Correlations are presented to show the effectiveness and relative effectiveness of film and transpiration cooling both with and in the absence of shockwave/boundary layer interaction. The aerothermal and aero-optical performance of seekerheads for hypersonic interceptors represents currently one of the most key areas in hypersonic technology. The techniques that are being employed to obtain measurements of the aerothermal and aero-optical performance in the LENS facility are briefly reviewed. Finally, we present information on the 'CUBDAT' database of hypersonic measurements which have been assembled from fundamental studies of the phenomena discussed in this segment of the lecture series.
Author
Viscous Flow; Inviscid Flow; Real Gases; Hypersonic Flow; Hypersonics; Gas Flow; Boundary Layer Transition; Film Cooling; Shock Wave Interaction; Aerothermodynamics

19970009354 NASA Lewis Research Center, Cleveland, OH USA

Development of an Aeroelastic Code Based on an Euler/Navier-Stokes Aerodynamic Solver

Bakhle, Milind A., Toledo Univ., USA; Srivastava, Rakesh, Toledo Univ., USA; Keith, Theo G., Jr., Toledo Univ., USA; Stefko, George L., NASA Lewis Research Center, USA; Janus, Mark J., Mississippi State Univ., USA; Nov. 1996; 20p; In English

Contract(s)/Grant(s): NAG3-1803; RTOP 538-06-14

Report No.(s): NASA-TM-107362; NAS 1.15:107362; E-10523; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper describes the development of an aeroelastic code (TURBO-AE) based on an Euler/Navier-Stokes unsteady aerodynamic analysis. A brief review of the relevant research in the area of propulsion aeroelasticity is presented. The paper briefly describes the original Euler/Navier-Stokes code (TURBO) and then details the development of the aeroelastic extensions. The aeroelastic formulation is described. The modeling of the dynamics of the blade using a modal approach is detailed, along with the grid deformation approach used to model the elastic deformation of the blade. The work-per-cycle approach used to evaluate aeroelastic stability is described. Representative results used to verify the code are presented. The paper concludes with an evaluation of the development thus far, and some plans for further development and validation of the TURBO-AE code.

Author

Aeroelasticity; Unsteady Aerodynamics; Euler Equations of Motion; Navier-Stokes Equation; Rotor Dynamics; Computer Programs

13
GEOSCIENCES

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

19970008013 Naval Postgraduate School, Monterey, CA USA

Optimal Routing of Ice Reconnaissance Aircraft

Sposato, Joseph J., Naval Postgraduate School, USA; Sep. 1995; 72p; In English

Report No.(s): AD-A311724; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The USA Coast Guard (USCG) conducts the international ice Patrol (IIP) in the North Atlantic. The primary mission of the lip is to identify the Limits of All Known Ice (the southeastern, southern and southwestern limits of the iceberg region in the vicinity of the Grand Banks of Newfoundland) and to disseminate this information to mariners. The lip routinely flies reconnaissance missions during the ice season to help locate the Limits of All Known Ice. This thesis develops an algorithm that, given a set of priorities, determines the optimal routes to fly during these reconnaissance missions. The algorithm relies on partitioning the operation area into squares where the length of each square's side is the IIP radar or visual identification range. Each square has a reward assigned using lip priorities which include location of the node, it's proximity to the Limits of All Known Ice, whether or not known icebergs are near it, and the time since it was last visited. The algorithm picks the route that conforms to lip operating procedures with total greatest reward for nodes searched. The algorithm enumerates all routes obeying IIP operational procedures within a few seconds guaranteeing an optimal solution. When compared to actual flights flown by the IIP, routes produced by the algorithm better satisfy USCG defined priorities.

DTIC

Algorithms; Reconnaissance Aircraft; Ice Mapping; Optimization; Visual Perception; Flight Paths; Ice Reporting

14
LIFE SCIENCES

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

19970008012 Army Aeromedical Research Lab., Fort Rucker, AL USA

Counterweights Used with ANVIS *Final Report*

McLean, Bill, Army Aeromedical Research Lab., USA; Shannon, Samuel, Army Aeromedical Research Lab., USA; McEntire, Joe, Army Aeromedical Research Lab., USA; Armstrong, Scott, Army Aeromedical Research Lab., USA; Jul. 1996; 27p; In English

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

Report No.(s): AD-A311728; USAARL-96-30; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A survey was conducted at Fort Rucker, Alabama, on the use of counterweights with the aviator night vision imaging system (ANVIS). The purposes of the survey were to determine frequency and purpose of counterweight use, materials used, and actual weight of the counterweights. Thirty-seven night vision goggle (NVG) instructor pilots (IPs) and nineteen NVG student pilots contributed to this survey. NVG participants flew four different aircraft types located at three different airfields. The results showed that 76 percent of the NVG IPs used counterweights. Average weight for the counterweights was 13 oz with a minimum of 8.9 and a maximum of 22 oz. For the graduating NVG student pilots, 100 percent used counterweights. The average counterweight used by the students was 11.7 oz with a minimum of 3.4 and a maximum of 20.1 oz. The two primary reasons listed for using counterweights were to reduce the helmet from rotating forward and to relieve neck strain. The most common type of counterweight consisted of a standard issued cloth bag with two to three rolls of pennies. In the heaviest possible configuration, the head supported weight with ANVIS could be as much as 7.3 pounds lbs, which includes an X-Large SPH-4 helmet, 25-mm eyepiece ANVIS with dual battery pack and AA batteries, 20 oz of counterweight, a lip light, and an ANVIS head-up diay (HUD). of the 37 NVG IPs surveyed, the average estimated head supported weight with ANVIS was 4.7 lbs, with a minimum of 4.7 and a maximum of 6.8 lbs. With the addition of a protective mask the total weight would increase by approximately 2 pounds.
DTIC
Aircraft Pilots; Night Vision; Pilot Performance; Night Flights (Aircraft); Dark Adaptation

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.

19970009250 Daimler-Benz Aerospace A.G., Militarflugzeuge, Munich, Germany
Aerothermodynamics of Radiation-Cooled Surfaces
Hirschel, E. H., Daimler-Benz Aerospace A.G., Germany; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 16p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This lecture introduces to the aerothermodynamics of radiation-cooled surfaces of high-speed flight vehicles operating in the earth atmosphere at speeds below approximately 8 km/s. After a discussion of the technical background of heat loads at hypersonic flight, a simple analysis shows how the radiation-adiabatic temperature qualitatively depends on the local boundary-layer properties. Computed examples illustrate the findings and show the implications of radiation cooling for the vehicle design. Scaling laws and non-convex effects are treated, and the influence of radiation cooling on several surface phenomena is considered. Finally, the need of a hot experimental technique is discussed and a possible integrated aerothermodynamic design approach is sketched.
Author
Aerothermodynamics; Radiant Cooling; Hypersonic Flight

19970009253 Dassault Aviation, Saint-Cloud, France
Configurational Aerothermodynamics of RAM and SCRAM Propelled Vehicles
Perrier, P., Dassault Aviation, France; Courty, J. C., Dassault Aviation, France; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 36p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Numerical and experimental tools are available for effective design of RAM and SCRAM propelled vehicles. Taking into consideration that flight conditions are not well duplicated in wind tunnel tests for high entropy flow, performance prediction should be supported by both calculations and experiments. An efficient multidisciplinary approach should account for all constraints placed by aerothermal and aerodynamic factors.
Derived from text
Aerothermodynamics; Performance Prediction; Aerodynamic Configurations; Aircraft Configurations; Hypersonic Vehicles

19970009258 Aerospatiale Missiles, Chatillon, France
Missile Aerothermodynamics and Propulsion Integration
Pagen, D., Aerospatiale Missiles, France; Lacau, R.-G., Aerospatiale Missiles, France; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 44p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This lecture provides a general review of aerothermodynamics and propulsion integration of supersonic and hypersonic missiles. We focus on the major design problems and the simulation means with their potentials and deficits. Considered design problems are external aerothermodynamics, including the specific problem of lateral jet control, and the ramjet/scramjet propulsion integration. Simulation means cover Computational Fluid Dynamics (CFD) tools as well as ground test facilities. The last part of the lecture illustrates the feasibility to use CFD tools in the design process as a complementary approach to wind tunnels, propulsion benches and flight tests.
Author
Aerothermodynamics; Missiles; Propulsion System Performance; Supersonic Combustion Ramjet Engines; Systems Integration; Computational Fluid Dynamics

19970009259 Daimler-Benz Aerospace A.G., Space Infrastructures, Munich, Germany
Stage Separation Aerothermodynamics
Weiland, Claus, Daimler-Benz Aerospace A.G., Germany; Aerothermodynamics and Propulsion Integration for Hypersonic Vehicles; Oct. 1996; 28p; In English; Also announced as 19970009247; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Aerothermodynamic problems during the sequence of ascent flight are investigated. The flows for the pickaback configuration, the stage separation, the lower stage alone, inside of the trough of the lower stage and the fin/winglet interaction are considered. The main attention will be drawn to the stage separation process. During hypersonic flight the upper stage is separated from the lower stage which induces thereby a highly complicated flow field in the gap between the both stages, leading to aerodynamic and thermal loads. From the flight mechanical point of view the aerodynamic coefficients have to be determined, whereas for structures and thermal protection purposes the local loads are of most importance. Several physical aspects are examined for the various kinds of flows, i.e., wall radiation, turbulence, real gases, shock/boundary layer and shock/shock interaction, flow separation and reattachment. The flowfields are analyzed by employing numerical simulation methods as well as wind-tunnel experiments. Inviscid and viscous numerical simulations are performed applying the Euler and the Navier-Stokes equations. The influence of the grid fineness on the accuracy of the numerical results are also object of consideration. Results of the above described flow cases will be presented and discussed in very detail and the windtunnel data will be compared with the numerical results for validation reasons.
Author
Stage Separation; Aerothermodynamics; Ascent; Hypersonic Speed; Flow Distribution; Separated Flow; Shock Wave Interaction; Navier-Stokes Equation; Computational Fluid Dynamics

17
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19970008142 NASA Langley Research Center, Hampton, VA USA
Legacy: General Aviation Highlights from 8 Decades of NACA/NASA Research
Adkins, SUSAn L., NASA Langley Research Center, USA; Strain, Natale A., NASA Langley Research Center, USA; Robinson, Stephen K., NASA Langley Research Center, USA; 1995; In English; CD-ROM: CD-ROM operates on Mac, Windows, or DOS platforms
Report No.(s): NASA-TM-111596; NAS 1.15:111596; PB95-503439; NONP-NASA-CD-96-1996067608; No Copyright; Avail: Issuing Activity (National Technical Information Service), CD-ROM

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CASI
Bibliographies; Data Bases; Aeronautics; Reports; General Aviation Aircraft; NASA Programs

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