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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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

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

04 Aircraft Communications and Navigation **7**

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

05 Aircraft Design, Testing and Performance **8**

Includes aircraft simulation technology.

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Includes cockpit and cabin display devices; and flight instruments.

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

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

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Typical Report Citation and Abstract

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

Key

1. Document ID Number; Corporate Source
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3. Author(s) and Affiliation(s)
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AERONAUTICAL ENGINEERING

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01
AERONAUTICS

19970029334 Advisory Group for Aerospace Research and Development, Structures and Materials Panel, Neuilly-Sur-Seine, France

Loads and Requirements for Military Aircraft ***Les Charges et les Specifications des Avions Militaires***

Feb. 1997; 176p; In English; In French; 83rd; AGARD Structures and Materials Panel, 4-5 Sep. 1996, Florence, Italy; Also announced as 19970029335 through 19970029346

Report No.(s): AGARD-R-815; ISBN-92-836-0037-1; Copyright Waived; Avail: CASI; A09, Hardcopy; A02, Microfiche

Since the beginning of aircraft design and certification, loads and loads-related requirements have continued to evolve, while the initial conservative assumptions related to safety factors have remained essentially the same over the years. The technology and analysis tools have also evolved substantially in several areas: for example the increased use of computational/experimental methods in the areas of maneuvering loads; the characterization of buffet; the increased use of stochastic methods for gust loads; and the improved knowledge of fatigue life impact on design. On the other hand, the quest for lighter and higher performance aircraft led to the development of new technologies such as Electronic Flight Control Systems (EFCS) and thrust vectoring systems. With the increased use of these technologies and the improved quantification of factors influencing loads, the initial concept of safety factors and also some of the bases of military standards for military aircraft needed to be re-visited. It was observed in the Workshop that there was not much advantage in trying to reduce the safety factors for a new aircraft but that it might be effective to do so for an aircraft modification after a change of role, for instance. Reserves were also expressed as to the danger of optimizing a design for an initial use. It was considered advisable to remain conservative in order to accommodate changes in role during the life of an aircraft, especially a fighter aircraft. The effects of failures of EFCS on loads envelopes were also presented, showing that in certain cases an aircraft designed according to a functional EFCS could exceed the design load envelope when a failure of EFCS occurred, thus arguing for a certain conservatism in design. It was concluded, that some level of conservatism was still required but that new criteria and methods should be investigated in order to propose standards for future aircraft design.
Author

Aircraft Design; Fighter Aircraft; Loads (Forces); Structural Analysis; Certification; Flight Control; Thrust Vector Control

19970029347 Advisory Group for Aerospace Research and Development, Mission Systems Panel, Neuilly-Sur-Seine, France

Advanced Architectures for Aerospace Mission Systems ***Architectures Futures pour l'Avionique de Gestion de Mission***

Jul. 1997; 312p; In English; In French; 6th, 14-17 Oct. 1996, Istanbul, Turkey; Also announced as 19970029348 through 19970029377; Original contains color illustrations

Report No.(s): AGARD-CP-581; ISBN-92-836-0044-4; Copyright Waived; Avail: CASI; A14, Hardcopy; A03, Microfiche

This volume contains the Technical Evaluation Report and the 30 unclassified papers, presented at the Mission Systems Panel Symposium held in Istanbul, Turkey, 14-17 October 1996. The papers presented covered the following headings: Invited Papers; Military Applications of Civil Systems; Communications (Systems); Communications (Technology); Surveillance (Reconnaissance); Surveillance (Meteorology); Surveillance (Early Warning); Information Extraction; Vehicle Management; Future Systems and Panel Discussion.
Author

Aerospace Environments; Meteorology; Military Technology; Reconnaissance; Surveillance

19970030196 National Academy of Sciences - National Research Council, Aeronautics and Space Engineering Board, Washington, DC USA

Aeronautics Technology Possibilities for 2000: Report of a Workshop

Aeronautics Technology Possibilities for 2000: Report of a Workshop; 1984; 245p; In English, Jan. 1984, Austin, TX, USA; Also announced as 19970030197 through 19970030204

Contract(s)/Grant(s): NASw-3455

Report No.(s): NASA-CR-205283; NAS 1.26:205283; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Topics discussed include: Aerodynamics; Propulsion; Structural Analysis and Design Technology; Materials for Structural Members, Propulsion Systems, and Subsystems; Guidance, Navigation, and Control; Computer and Information Technology; Human Factors Engineering; Systems Integration.

Derived from text

Aerodynamics; Aeronautical Engineering; Information Systems; Propulsion System Configurations; Propulsion System Performance; Structural Analysis; Systems Integration; Computer Systems Design

02
AERODYNAMICS

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

19970028760 Lehigh Univ., Dept. of Mechanical Engineering and Mechanics, Bethlehem, PA USA

Unsteady Three-Dimensional Aerodynamic Flow ***Final Report, 15 Feb. 1995 - 14 Feb. 1997***

Rockwell, Donald, Lehigh Univ., USA; Feb. 28, 1997; 7p; In English

Contract(s)/Grant(s): F49620-95-I-0220

Report No.(s): AD-A326174; AFOSR-TR-97-0289; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The overall objective of this program is to determine the instantaneous flow structure on delta wings at high angle of attack as well as from cylindrical bodies, which are subjected to basic classes of motion. New techniques of high image density particle image velocimetry provide the instantaneous vorticity fields and streamline patterns, thereby allowing interpretation of the underlying physics using critical point theory. This type of quantitative interpretation of the flow structure is crucial for performing vorticity balances on wings and bodies and thereby optimization of overall performance characteristics. Furthermore, for the case of the delta wing at high angle of attack, local control techniques are applied simultaneously at leading and trailing edges of the wing, in order to alter the crucial features of vortex breakdown and subsequent large scale stall. Such control techniques have application to a wide variety of separated flows from wings and cylindrical bodies.

DTIC

Unsteady Aerodynamics; Three Dimensional Flow; Delta Wings; Cylindrical Bodies; Separated Flow; Vortex Breakdown; Aerodynamic Characteristics; Fluid Flow; Control Systems Design

19970028835 Washington Univ., Seattle, WA USA

Reynolds Number Trends in Computational Solutions of Two-Dimensional Airfoils with Taguchi Techniques and Grid Resolution

Pluntze, Stephen C., Washington Univ., USA; Jun. 18, 1997; 171p; In English

Report No.(s): AD-A326844; AFIT-97-015D; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

A procedure is proposed which allows the extension of incompressible high Reynolds Number wind tunnel data to even higher incompressible flight Reynolds Numbers using a computational solution about the airfoil. The new procedure is predicated on the performance of different grid refinements and turbulence models versus functions of y+, the vertical scaling parameter. When the difference between the computational force coefficients and the wind tunnel force coefficients are plotted against the log10(y+) or log10(y+/(square root of Re)), the data for the higher wind tunnel Reynolds numbers (approx. 2 x 10(exp 6) - 1 x 10(exp 7)) falls on one line. This behavior is noted for different thicknesses of airfoils at different angles of attack from zero lift to C(lmax), although the corrected y+ ordinate is required only with moderate to high angle of attack. The airfoil is tested in the wind tunnel with enough Reynolds numbers to establish a trend and the computational solution is carried out at the same Reynolds numbers and angles of attack. Corrected flight Reynolds number Cd and Cl values appear to asymptote correctly on a trend curve showing force coefficient with Reynolds number. A statistical measure, adapted from Taguchi Techniques of quality control provides a measure of comparing the importance of turbulence model, angle of attack, Reynolds number, and wall spacing to the analysis. It is used for the first time here to help evaluate the performance of a computational solver. Taguchi results show that wall spacing is often, but not always, the most important parameter, and that the importance of turbulence model and Reynolds

number is very dependent on the airfoil and whether lift or drag is being examined. Excursions carried out include different grid stretching and a possible extension from 2 to 3 dimensional.
DTIC
Wind Tunnel Tests; Turbulence Models; High Reynolds Number; Computational Grids; Airfoils; Computational Fluid Dynamics; Two Dimensional Flow; Incompressible Flow

19970029426 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Inst. fuer Antriebstechnik, Cologne, Germany
Analysis of the Flow in the Exit of Propfans ***Analyse der Raeumlichen Stroemung im Austritt Eines Propfans***
Maass, Martin, Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Germany; 1996; ISSN 0939-2963; 124p; In German; Original contains color illustrations
Report No.(s): DLR-FB-96-07; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

In this work the first rotor of a counterrotating shrouded propfan has been investigated to enable an overview of the complex rotor exit flow, based on unsteady measurements. For this purpose the accuracy of the high speed probe technique has been improved. In combination with the 3D-Laser-2-Focus system measurements were carried out in order to show the turbulent behaviour of the rotor exit flow. Though the turbulence models are presently not sufficiently developed, comparisons with results of numerical flow simulations are used to interpret some wake details. A further focal point of this work is to determine the local losses for quantifying the isentropic efficiency and the pressure loss distribution. These investigations on the compressor's exit flow can be used as a base for code validation and as design data for the next stage.
Author
Flow Measurement; Prop-Fan Technology; Rotors; Turbulence Models

19970029432 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Inst. fuer Stroemungsmechanik, Goettingen, Germany
Investigation of Helicopter Rotor Blade Tip Vorticies by Means of a 3 Component Laser-Doppler Velocimeter ***Untersuchung von Rotorblattspitzenwirbeln Mittels Eines 3 Komponenten Laser-Doppler Anemometers***
Seelhorst, Ulrich, Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Germany; 1996; ISSN 0939-2963; 114p; In German; Original contains color illustration
Report No.(s): DLR-FB-96-15; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The influence of non-planar blade tips (winglet), respectively the influence of higher-harmonic control, on the three-dimensional flow field of blade tip vorticies has been investigated with a specially modified 3 component laser-Doppler velocimeter for the first time on a rotating helicopter rotor blade in the German-Dutsch Windtunnel (DNW) with a working distance of 5 m. By means of a phase correlated measuring method, both spatial and temporal information on the structure of these blade tip vorticies could be obtained. The results show, that due to the non-planar blade tip the spatial structure and the position of the tip vortex could be changed. The effect of higher harmonic control on the measured flow field clearly indicates the differences due to the higher harmonic control settings.
Author
Rotary Wings; Vortices; Laser Doppler Velocimeters

19970029433 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Inst. fuer Entwurfsaerodynamik, Brunswick, Germany
Investigations Concerning Laminarization of Wings with Supersonic Leading Edge ***Untersuchungen Zur Lamunarhaltung von Tragfluegeln mit Ueberschallvorderkante***
Stilla, Joachim, Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Germany; 1996; ISSN 0939-2963; 118p; In German
Report No.(s): DLR-FB-96-23; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Laminarization might be a means to enhance the lift over drag ratio of second generation supersonic aircraft. In the work presented here an infinite swept wing with supersonic leading edge and slab- wedge-slab profile has been investigated under realistic freestream conditions. by using existing methods for mean flow computation and stability analysis an engineering tool for transition prediction has been provided. For mean-flow computation an Euler/boundary-layer method including second-order boundary-layer theory is used. Transition prediction is done by means of the well known e(sup N) method. Detailed computations for the purpose of validation showed good agreement of the results with those of several references. The results concerning laminarization show that the nose of profiles in the supersonic leading edge region should be designed as wedge, which should be as long as possible. Furthermore, near the leading edge crossfiow instabilities were not detected on the basis of local, linear stability theory

even if viscous interaction was considered. Utilizing moderate suction leads to transition locations beyond 40% chord length. The presented work also includes suggestions for a transition experiment.
Author
Laminar Flow; Leading Edges; Supersonic Aircraft; Swept Wings

19970030197 National Academy of Sciences - National Research Council, Panel on Aerodynamics, Washington, DC USA
Report of the Panel on Aerodynamics
Bradley, Richard G., General Dynamics Corp., USA; Bushnell, Dennis, NASA Langley Research Center, USA; Aeronautics Technology Possibilities for 2000: Report of a Workshop; 1984, pp. 15-46; In English; Also announced as 19970030196; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Progress in aerodynamics over the past 50 years has been evidenced by the development of increasingly sophisticated and efficient flight vehicles throughout the flight spectrum. Advances have generally arisen in an evolutionary manner from experience gained in wind tunnel testing, flight testing, and improvements in analytical and computational capabilities. As a result of this evolutionary development, both military and commercial vehicles operate at a relatively high efficiency level. This observation plus the fact that airplanes have not changed appreciably in outward appearance over recent years has led some skeptics to conclude incorrectly that aerodynamics is a mature technology, with little to be gained from further developments in the field. It is of interest to note that progress in aerodynamics has occurred without a thorough understanding of the fundamental physics of flow, turbulence, vortex dynamics, and separated flow, for example. The present understanding of transition, turbulence, and boundary layer separation is actually very limited. However, these fundamental flow phenomena provide the key to reducing the viscous drag of aircraft. Drag reduction provides the greatest potential for increased flight efficiency from the standpoint of both saving energy and maximizing performance. Recent advances have led to innovative concepts for reducing turbulent friction drag by modifying the turbulent structure within the boundary layer. Further advances in this basic area should lead to methods for reducing skin friction drag significantly. The current challenges for military aircraft open entirely new fields of investigation for the aerodynamicist. The ability through very high speed information processing technology to totally integrate the flight and propulsion controls can permit an aircraft to fly with ”complete abandon,” avoiding departure, buffet, and other undesirable characteristics. to utilize these new control concepts, complex aerodynamic phenomena will have to be understood, predicted, and controlled. Current requirements for military aircraft include configuration optimization through a widened envelope from subsonic to supersonic and from low to high angles of attack. This task is further complicated by requirements for control of observables. These challenging new designs do not have the luxury of a large experimental data base from which to optimize for various parameter combinations. Consequently, there exists a strong need for better techniques, both experimental and computational, to permit design optimization in a complete sense.
Derived from text
Drag Reduction; Aerodynamic Characteristics; Aerodynamic Drag; Aerodynamics; Vortices; Computational Fluid Dynamics; Design Analysis; Data Processing; Computer Systems Performance

19970030311 NASA Langley Research Center, Hampton, VA, USA
Fin leading-edge sweep effect on shock-shock interaction at Mach 6
Berry, Scott A., NASA Langley Research Cent, USA; Nowak, Robert J., NASA Langley Research Center, USA; Journal of Spacecraft and Rockets; July 1997; ISSN 0022-4650; vol. 34, no. 4, pp. 416-425; In English; Copyright; Avail: Issuing Activity

The effects of fin leading-edge on peak heating rates due to shock-shock interaction have been experimentally examined in a Mach 6 wind tunnel. The shock interaction was produced by the intersection of a planar incident shock with the bow shock formed around a 0.5-in.-diam cylindrical leading edge fin. Two models using were utilized, one with 0.025-in spacing between gauge centers, and the other with 0.015-in spacing. Gauge spatial resolution on the order of 0.015 in appeared to capture the narrow heating spike accurately. The schlieren images of the models revealed Type IV and Type III interactions, respectively.
Author (EI)
Flow Characteristics; Heat Transfer; Leading Edge Sweep; Mach Number; Shock Wave Interaction; Shock Waves; Sweep Effect; Wind Tunnels

19970030312
Numerical study of shock-wave reflections from a wedge with surface roughness
Sakamura, Yoshitaka, Toyama Prefectural Univ, Japan; Suzuki, Tateyuki; Transactions of the Japan Society for Aeronautical and Space Sciences; May 1997; ISSN 0549-3811; vol. 40, no. 127, pp. 30-39; In English; Copyright; Avail: Issuing Activity

Numerical simulations of shock-wave reflections from a wedge with surface roughness are performed using a two-dimensional finite-volume generalized-Riemann-problem (GRP) scheme. The surface roughness is simulated by two-dimensional

square cavities (gutters), which are formed on a wedge surface with regular intervals. The numerical results are compared with shadowgraphs obtained from shock-tube experiments, with excellent agreement. The formation and propagation of a secondary reflected shock wave, which plays a key role in the shock-wave reflection from a multi-guttered wedge, are revealed and discussed in the present numerical study.
Author (EI)
Cauchy Problem; Shock Waves; Sound Waves; Surface Roughness; Wave Reflection

03
AIR TRANSPORTATION AND SAFETY

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

19970028778 NASA Ames Research Center, Moffett Field, CA USA
The Challenges of Field Testing the Traffic Management Advisor (TMA) in an Operational Air Traffic Control Facility
Hoang, Ty, NASA Ames Research Center, USA; Swenson, Harry N., NASA Ames Research Center, USA; Aug. 1997; 16p; In English
Report No.(s): NASA-TM-112211; NAS 1.15:112211; A-977300; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Traffic Management Advisor (TMA), the sequence and schedule tool of the Center/TRACON Automation System (CTAS), was evaluated at the Fort Worth Center (ZFW) in the summer of 1996. This paper describes the challenges encountered during the various phases of the TMA field evaluation, which included system (hardware and software) installation, personnel training, and data collection. Operational procedures were developed and applied to the evaluation process that would ensure air safety. The five weeks of field evaluation imposed minimal impact on the hosting facility and provided valuable engineering and human factors data. The collection of data was very much an opportunistic affair, due to dynamic traffic conditions. One measure of the success of the TMA evaluation is that, rather than remove TMA after the evaluation until it could be fully implemented, the prototype TMA is in continual use at ZFW as the fully operational version is readied for implementation.
Author
Human Factors Engineering; Ground Based Control; Air Traffic Control; Aircraft Safety; Automatic Control; Flight Safety

19970028847 Defense Science Board, Washington, DC USA
Report of the Defense Science Board Task Force on Aviation Safety *Final Report*
Randolph, Randy, Defense Science Board, USA; Feb. 1997; 71p; In English
Report No.(s): AD-A327417; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Task Force was formed in November 1996. It met formally eight times. Three of those meetings took place at the Safety Centers of the Army, Navy (Marine) and Air Force. The objective of the study was to make recommendations regarding ways to reduce the rate of military aviation accidents, and, more importantly, to reduce the recent rise in loss of life that accompanies these avoidable events. The following specific tasks were outlined in the Terms of Reference (TOR): TOR#1- Determine the need/value of a joint program to require a standardized process for reporting and assessing the causes of accidents. TOR#2- Determine the effectiveness of methods presently used to disseminate lessons learned to help prevent accidents. TOR#3- Recommend new approaches to reduce the incidence of recurring safety problems. These problems include accident causal factors such as human error and controlled flight into terrain. TOR#4- Assess the need for a DoD-wide Human Performance network to improve the identification and dissemination of lessons learned across the Services. TOR#5- Recommend new approaches to institutionalize risk management within the Services. TOR#6- Provide recommendations concerning flight safety technologies that should be installed on each type of aircraft.
DTIC
Aircraft Safety; Aircraft Accidents; Safety Factors; Flight Safety; Flight Control; Human Factors Engineering

19970028995 National Transportation Safety Board, Office of Judges, Washington, DC USA
National Transportation Safety Board Transportation Initial Decisions and Orders and Board Opinions and Orders Adopted and Issued during the Month of December 1996
Dec. 1996; 421p; In English
Report No.(s): PB96-916712; NTSB/IDB00-96/12; No Copyright; Avail: CASI; A18, Hardcopy; A04, Microfiche

This publication contains all Judge Initial Decisions and Board Opinions and Orders in Safety and Seaman Enforcement Cases for December 1996.
NTIS
Accident Prevention; Air Transportation

19970029130 Army Aeromedical Research Lab., Aircrew Health and Performance Div., Fort Rucker, AL USA
An Assessment of Luminance Imbalance with ANVIS at an Army Helicopter Training Airfield ***Final Report***
McLean, William E., Army Aeromedical Research Lab., USA; May 1997; 39p; In English
Contract(s)/Grant(s): DA Proj. 3M1-62787-A-879
Report No.(s): AD-A327266; USAARL-97-21; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

One of the casual factors listed in a 1996 mid-air collision between two Australian Army helicopters in formation was a speculation of possible luminance imbalance between the right and left channels of the night vision goggles (NVGs) at the airfield of origin for the two helicopters involved in the accident. This study describes a field method of measuring and determining luminance output and imbalance for 20 pair of NVGs at a U.S. Army airfield. The luminance source to activate the aviator night vision imaging system (ANVIS) was a calibrated NVG test set (TS-3895 U/V). The photopic sensor of an illuminance radiometer was placed on the eyepieces of the ANVIS and relative illuminance values were taken for each channel at light levels above and below the automatic brightness control (ABC) level in the ANVIS power supply. The light level above the ABC limits the upper luminance output and the level below the ABC is a function of the ANVIS gain. In the laboratory, the illuminance values from the radiometer were calibrated to luminance values using the same NVG test set for the light source and a Pritchard 1980A photometer. The results showed a significant correlation between the luminance values from the right and left eyepieces above or below the ABC level, but the correlation below levels for the same tube was not significant. It was also found that 80 percent of the surveyed ANVIS that had been routinely used for several years did not meet the suggested 10 percent luminance imbalance criteria for either above or below the ABC level. The implication from this study is that the 10 percent imbalance criteria is not realistic from a measuring or user acceptable standpoint.
DTIC
Aircraft Pilots; Illuminance; Night Vision; Goggles; Brightness; Automatic Control; Helicopters; Imaging Techniques

19970029198 Glasgow Univ., Dept. of Computing Science, UK
Proving Properties of Accidents
Johnson, C. W., Glasgow Univ., UK; Fourth NASA Langley Formal Methods Workshop; Sep. 1997, pp. 21-34; In English; Also announced as 19970029195
Contract(s)/Grant(s): GR/J-07686; GR/K-55042; GR/K-69148; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Accident reports are produced by regulatory and commercial authorities, such as the UK Air Accident Investigation Branch and the US National Transportation Safety Board, in response to most major accidents. They, typically, contain accounts of the human and system failures that lead to major accidents. These descriptions are then used to identify the primary and secondary causes of the failure. Finally, recommendations are made so that the operators and regulators of safety-critical systems can avoid future accidents. Unfortunately, it is often difficult for readers to trace the way in which particular conclusions are drawn from many hundreds of pages of evidence. Natural language arguments often contain implicit assumptions and ambiguous remarks that prevent readers from understanding the reasons why a particular conclusion was drawn from a particular accident. This paper argues that mathematical proof techniques can be used to support the findings of accident investigations. These techniques enable analysts to formally demonstrate that a particular conclusion is justified given the evidence in a report. Conclusion, Analysis and Evidence diagrams can then be used to communicate the results of a formal analysis. The intention is not to replace the natural argumentation structures that are currently used in accident reports. Rather, our aim is to increase confidence that particular conclusions are well supported by the evidence that is presented within a report.
Author
Accident Investigation; Aircraft Accidents; System Failures; Human Performance; Failure Analysis

19970030309
Aircraft ice accretion measurement: A Phase I, SBIR study using millimeter wave radar (MMWR)
Lightfoot, Fred M., Fred M. Lightfoot & Associates, Inc, USA; Milligan, Robert E.; IEEE Aerospace and Electronic Systems Magazine; August 1997; ISSN 0885-8985; vol. 12, no. 8, pp. 3-9; In English; Copyright; Avail: Issuing Activity

The Communication and Electronic Command, Fort Monmouth, NJ, proposed Phase I bids to study the feasibility of using millimeter wave radar (MMWR) techniques to measure the amount of ice accumulated on aircraft wings and rotors. The MMW phenomenology used two modes, radiometric and coherent radar. The various features or discriminates of the accretion deposits

on aircraft structures that characterize the icing condition is examined. A series of tests were conducted to validate the hypothesis and assist the development of a design philosophy for a practical MMW radar.
Author (EI)
Ice; Millimeter Waves; Radar Equipment; Radar Measurement; Textures

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

19970029199 British Columbia Univ., Dept. of Computer Science, Vancouver, British Columbia Canada
Formalization and Analysis of the Separation Minima for Aircraft in the North Atlantic Region
Day, Nancy A., British Columbia Univ., Canada; Joyce, Jeffrey J., Hughes International Airspace Management Systems, Canada; Pelletier, Gerry, Hughes International Airspace Management Systems, Canada; Fourth NASA Langley Formal Methods Workshop; Sep. 1997, pp. 35-49; In English; Also announced as 19970029195; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The formalization and analysis of an air traffic control separation minima serves in this paper as an illustration of an approach that uses formal operational semantics to drive the automated analysis of specifications. This contrasts with the approach of translating one notation into the input format for an analysis tool, or hard-coding the semantics of a particular notation into the implementation of an analysis technique. The semantic functions capture the structure of the specification and can be directly evaluated to map a notation to a rigourous mathematical foundation. This work contributes to a greater appreciation of how the structure of a specification (e.g., the organization of a table), not just the semantics, is an important input to many analysis functions. Building upon a common mathematical foundation, different notations can be combined to support an integrated approach to the analysis of a formal specification. A related issue is the importance of being able to reverse the effect of the semantic functions so that analysis results are provided to users at the same level of abstraction used in the input specifications. The formalization of the separation minima combines the use of a tabular style of specification with predicate logic. This paper discusses how automated analysis functions were applied to the specification to check for the properties of consistency, completeness and symmetry. The benefit of doing this analysis is demonstrated by the discovery of an ambiguity in the separation minima.
Author
Air Traffic Control; Semantics; Formalism; Minima; Applications Programs (Computers); Proving

19970030201 National Academy of Sciences - National Research Council, Panel on Guidance, Navigation and Control, Washington, DC USA
Report of the Panel on Guidance, Navigation, and Control
Fraser, Donald C., Draper (Charles Stark) Lab., Inc., USA; Szalai, Kenneth J., NASA Ames Research Center, USA; Aeronautics Technology Possibilities for 2000: Report of a Workshop; 1984, pp. 129-156; In English; Also announced as 19970030196; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Guidance, navigation, and control (GNC) systems have historically been vital to improving operational capability of aircraft. The development of autopilots and electronic navigation systems has greatly aided the crew in flying precise routes in all weather conditions while at the same time reducing pilot workload. Advances in high-integrity onboard computing and electronics technology have resulted in a significant increase in the capability of these subsystems to perform more reliably, efficiently, and safely. Onboard computing and control system capability has provided new design approaches for the aircraft designer. by using automatic control systems to stabilize the aircraft, the designer can relax certain conventional aerodynamic stability requirements and achieve aircraft performance benefits. Thus, modern fighter aircraft are designed with low levels, or in fact, negative levels of longitudinal static stability to boost maneuvering capability and cruise performance, relying on the use of full-time, full-authority automatic stability augmentation systems to stabilize the aircraft. During the next 20 years, GNC systems will become a driving force in aircraft design. Instead of making separately designed major aircraft systems work together, the designer will exploit the interaction and integration of aerodynamic, structural, and propulsion system controls to provide a better aircraft. The benefits of such integrated designs have been demonstrated already. Integrated digital control of the engine inlet and autopilot systems on a NASA YF-12 research aircraft resulted in a range increase of 7 percent. A civil transport derivative using extensions on each wing and an active control system to minimize the requirement for structural modifications achieved significant cruise performance improvements. These are first-generation applications of advanced GNC systems. More significant benefits are achievable by the year 2000. Complete integration of aerodynamic, propulsion and structural controls, and mission avionics will provide dramatically better aircraft performance, new capability (low observability, supermaneuverability) and/or improved mission effec-

tiveness. This requires a concurrent, multidisciplinary design approach early in the design stage. The role of advanced GNC systems in future aircraft is not an option.
Derived from text
Navigation; Guidance (Motion); Active Control; Aerodynamic Stability; Automatic Pilots; Longitudinal Stability; Fighter Aircraft; Controllability

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970028718 North Carolina Agricultural and Technical State Univ., Human-Machine Systems Engineering Group Center, Greensboro, NC USA
A Fuzzy Metric for Cooper-Harper Flying Quality Measures
Strickland, Dara, North Carolina Agricultural and Technical State Univ., USA; Ntuen, Celestine, North Carolina Agricultural and Technical State Univ., USA; The First National Student Conference: NASA University Research Centers at Minority Institutions; 1997, pp. 350-353; In English; Also announced as 19970028662; Copyright Waived (NASA); Avail: CASI; A01, Hardcopy; A04, Microfiche

A Flight Handling Quality (FHQ) is a composite measure of performance used to assess how well a pilot responds to flight conditions. For many years the Cooper-Harper (CH) FHQ has been considered as the industrial standard. Because the CH-FHQ consists of opinions characterized by vagueness and impreciseness, fuzzy set models can be used to aggregate opinions expressed on the CH-FHQ scale. This paper presents a fuzzy composite measure for CH-FHQ. The metric is robust and insensitive to the scale of judgements.
Author
Fuzzy Sets; Flight Conditions; Quality Control

19970028834 Academy of Sciences of the Uzbek SSR, Physical -Technical Inst., Tashkent, Uzbekistan
Proceedings for the International Workshop on the Monitoring of Aircraft Structures *Final Report*
May 19, 1997; 269p; In English, 18-20 Sep. 1996, Tashkent, Uzbekistan; Sponsored by Academy of Sciences of the Uzbek SSR, Uzbekistan
Contract(s)/Grant(s): F617089-96-W-0071
Report No.(s): AD-A326728; EOARD-CSP-96-1002; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The Final Proceedings for International Workshop on the Monitoring of Aircraft Structures, 3-5 September 1996 The Topics covered include: use of undestroyed testing and heterogeneous semiconductor structures to estimate airframe components fatigue, aircraft strength and service life, aircraft's operating conditions too fit their specification.
DTIC
Conferences; Service Life; Aircraft Maintenance

19970028915 NASA Langley Research Center, Hampton, VA USA
Quasi-Static Viscoelasticity Loading Measurements of an Aircraft Tire
Mason, Angela J., NASA Langley Research Center, USA; Tanner, John A., NASA Langley Research Center, USA; Johnson, Arthur R., Army Research Lab., USA; Sep. 1997; 24p; In English
Contract(s)/Grant(s): RTOP 505-63-50-19
Report No.(s): NASA-TM-4779; NAS 1.15:4779; L-17609; ARL-TR-1402; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Stair-step loading, cyclic loading, and long-term relaxation tests were performed on an aircraft tire to observe the quasi-static viscoelastic response of the tire. The data indicate that the tire continues to respond viscoelastically even after it has been softened by deformation. Load relaxation data from the stair-step test at the 15,000-lb loading was fit to a monotonically decreasing Prony series.
Author
Viscoelasticity; Aircraft Tires; Prony Series; Least Squares Method; Static Loads

19970028983 Georgia Inst. of Tech., Atlanta, GA USA

An Algorithm for Integrated Subsystem Embodiment and System Synthesis

Lewis, Kemper, Georgia Inst. of Tech., USA; Aug. 1997; 532p; In English

Contract(s)/Grant(s): NAG-1-1564; NGT-51102L; NSF DMI-94-20405; RTOP 505-10-31-03

Report No.(s): NASA-CR-210732; NAS 1.26:201732; No Copyright; Avail: CASI; A23, Hardcopy; A04, Microfiche

Consider the statement,'A system has two coupled subsystems, one of which dominates the design process. Each subsystem consists of discrete and continuous variables, and is solved using sequential analysis and solution.' to address this type of statement in the design of complex systems, three steps are required, namely, the embodiment of the statement in terms of entities on a computer, the mathematical formulation of subsystem models, and the resulting solution and system synthesis. In complex system decomposition, the subsystems are not isolated, self-supporting entities. Information such as constraints, goals, and design variables may be shared between entities. But many times in engineering problems, full communication and cooperation does not exist, information is incomplete, or one subsystem may dominate the design. Additionally, these engineering problems give rise to mathematical models involving nonlinear functions of both discrete and continuous design variables. In this dissertation an algorithm is developed to handle these types of scenarios for the domain-independent integration of subsystem embodiment, coordination, and system synthesis using constructs from Decision-Based Design, Game Theory, and Multidisciplinary Design Optimization. Implementation of the concept in this dissertation involves testing of the hypotheses using example problems and a motivating case study involving the design of a subsonic passenger aircraft.

Author

Complex Systems; Algorithms; Sequential Analysis; Design Analysis; Mathematical Models; Decision Theory

19970029322 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

The Highly-Automated Airplane: Its Impact on Aviation Safety and an Analysis of Training Philosophy

Liu, Kuo K., Air Force Inst. of Tech., USA; Jun. 1997; 110p; In English

Report No.(s): AD-A327119; AFIT/GSM/LAC/97J-1; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Two Airbus accidents at Nagoya, Japan and Toulouse, France in April and June 1994 highlighted the problem of the highly-automated airplane and its interface with pilots. As technologies in the engineering design progress so quickly in airplane automation, training philosophies toward the 'glass cockpit' may need to be re-evaluated. Many pilots, young and old, praise the advantages brought by the new technology. On the other hand, many have complained about the increasing workload and the danger of automation features which are not in their control. In this thesis, I evaluate the accidents of the highly-automated airplane and the probable solutions which can be applied in the training phase to reduce the accident rates. The training philosophies given to the crewmembers remaining in the cockpit of highly-automated airplanes should guarantee flying safety with limited time and resources in the absence of rigorous regulations. Air transportation surely is the most popular business today and in the future. The machine has been updated to include more automatic controls. Now our concern is to upgrade the human capability to stay abreast of technology and keep flying safe. That is the reason for this thesis, whose contribution to aviation safety is to recommend adequate training philosophies for highly-automated airplane users.

DTIC

Aircraft Safety; Flight Safety; Man Machine Systems; Aircraft Accidents

19970029335 Dassault Aviation, Direction Generale Technique, Saint-Cloud, France

Evolution of Philosophy of Design Loads for Military Aircraft ***Evolution de la Philosophie des Charges de Dimensionnement des Avions Militaires***

Petiau, C., Dassault Aviation, France; Loads and Requirements for Military Aircraft; Feb. 1997; 8p; In French; Also announced as 19970029334; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

After a brief recall of the principles of design load definition resulting from classical regulations, we show the difficulties of their application for combat aircraft equipped with Electrical Flight Control System (E.F.C.S.). This has led to an integrated process, where definition of design loads and setting of E.F.C.S. has been coupled, aiming finally to guarantee keeping the aircraft within a limit strength domain. This evolution reinforces the definition principle of limit loads as maximum loads to be expected in service, yet, without need for links with regulation standard maneuvers. We present the main aspects of this process, which includes: the definition of load severity indicators, and the elaboration of corresponding calculation operators; systematic calculations of these indicators during flight mechanics simulations (including real time development flight simulators); use of mathe-

matical optimization techniques, allowing to handle exchange rate between maneuver performances and structural sizing. For general cases it is not proven that these evolutions could justify a modification of ultimate loads/limit loads safety factors.
Author
Flight Control; Loads (Forces); Systems Engineering; Design Analysis; Military Aircraft; Structural Design; Flight Load Recorders

19970029336 NASA Lewis Research Center, Cleveland, OH USA
Probabilistic Approaches: Composite Design
Chamis, Christos C., NASA Lewis Research Center, USA; Loads and Requirements for Military Aircraft; Feb. 1997; 14p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

Probabilistic composite design is described in terms of a computational simulation. This simulation tracks probabilistically the composite design evolution from constituent materials, fabrication process through composite mechanics, and structural component. Comparisons with experimental data are provided to illustrate selection of probabilistic design allowables, test methods/specimen guidelines, and identification of in situ versus pristine strength. For example, results show that: in situ fiber tensile strength is 90 percent of its pristine strength; flat-wise long-tapered specimens are most suitable for setting ply tensile strength allowables; a composite radome can be designed with a reliability of 0.999999; and laminate fatigue exhibits wide spread scatter at 90 percent cyclic-stress to static-strength ratios.
Author
Structural Design; Composite Structures; Fabrication; Reliability Analysis; Computer Programs; Design Analysis; Graphite-Epoxy Composites; Structural Analysis; Structural Design Criteria; Laminates

19970029337 Daimler-Benz Aerospace A.G., Bremen, Germany
Determination and Verification of Operational Maneuver Parameters and Time Histories
Molkenthin, J., Daimler-Benz Aerospace A.G., Germany; Feb. 1997; 16p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

This paper describes a procedure for the evaluation of operational maneuver parameters and time histories, with the goal, to derive loads from operational flight parameters. The basic assumption is that for each operational maneuver type performed, in service or simulation as a set of normalized parameter time histories can be verified, and are called Standard Maneuvers. The Standard Maneuver is obtained by normalization of amplitudes and maneuver time to make the parameters independent of intensity of the maneuver, flight condition, flight control system, mass configurations, and the aircraft type. This paper outlines the determination of the operational maneuver parameters, the identification process of the maneuver types, the normalization procedure, the determination and verification of the Standard Maneuver time histories.
Author
Aerodynamic Loads; Flight Control; Design Analysis; Structural Design Criteria; Systems Engineering; Aircraft Maneuvers; Structural Design

19970029338 Daimler-Benz Aerospace A.G., Bremen, Germany
Flight Loads Derived from Operational Maneuvers
Struck, H., Daimler-Benz Aerospace A.G., Germany; Perron, C., Bombardier, Inc., Canada; Feb. 1997; 16p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

This paper describes the feasibility for the determination of operational loads applying an operational Maneuver Model. The essential input for the Maneuver Model is a set of Standard Maneuvers consisting of normalized operational parameter time histories. Operational external loads can be determined for: extreme operational loads, fatigue loads, and loads related to the operational parameters by introducing aircraft basic data, flight condition and boundary conditions for the maneuver to be considered. The application of the Maneuver Model is demonstrated for one aircraft. For some operational maneuvers the extreme operational loads are determined and compared with the design loads required by MIL-8861. The application of Standard Maneuver independent of the aircraft type has been demonstrated by determination of the loads applying the Standard Maneuver time histories from F-16 reconstituted to real time using the CF-18 performance data. The calculation of the loads has been performed using a proven Canadian loads calculation methodology and compared against flight test data of CF-18.
Author
Aerodynamic Loads; Flight Tests; Aircraft Maneuvers; Fighter Aircraft; Automatic Flight Control; Aircraft Design

19970029340 Daimler-Benz Aerospace A.G., Military Aircraft LMT2, Munich, Germany

The Impact of Dynamic Loads on the Design of Military Aircraft

Luber, W., Daimler-Benz Aerospace A.G., Germany; Becker, J., Daimler-Benz Aerospace A.G., Germany; Sensburg, O., Daimler-Benz Aerospace A.G., Germany; Feb. 1997; 28p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The layout of military aircraft structures is strongly influenced by dynamic loads from the early development phase onwards up to final design and clearance phase. Different dynamic loads have to be considered, namely dynamic gust loads, buffet loads on wing, fin, fuselage and also buffet loads from airbrakes, cavities and blisters, gunfire loads mainly at attachment frames and panels, Hammershock loads for air intake, bird strike and ammunition impact, acoustic loads for outer air intake and missile bays. Also dynamic loads from landing, jettison, brake chute and rough runway induced loads as well as wake induced loads may be designed. Dynamic loads resulting from flight test excitation like bunker input, stick jerks and control surface sweeps also have to be considered. For some of the designing dynamic loads, examples are given to explain their derivation and significance both for design of aircraft structural parts and related clearance aspects. Methods to derive dynamic design loads for different applications by using analytical and experimental tools will be presented. Validation methods for various design loads using dynamic model test results, wind tunnel model and flight test results are mentioned. The main purpose of this presentation is to indicate where dynamic loads would be dimensioning structures of future high performance combat airplanes and how to approach the problem of integrating all aspects into an optimum design.

Author

Aircraft Design; Aircraft Structures; Buffeting; Dynamic Loads; Flight Tests; Structural Design; Military Aircraft; Gust Loads; Structural Design Criteria

19970029341 British Aerospace Defence Ltd., Aerodynamics Dept., Preston, UK

Dynamic Loading Considerations in Design of Modern Combat Aircraft

Chapman, R., British Aerospace Defence Ltd., UK; Feb. 1997; 16p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The design and clearance for flight of recent aircraft has provided new challenges in the field of loads prediction and validation. Traditionally during the initial design phases of an aircraft project, dynamic loading effects have been covered by uncertainty tolerances applied to static loads. Only when structural or equipment qualification problems emerge during development testing, or worse in-service, have dynamic loading problems been fully addressed. The approach at BAe is to include dynamic loading at the design and development stage to a much greater extent than formerly. This is with the intention of reducing or eliminating the need for costly post-design investigations and/or structural redesign. This paper outlines the effects considered and some examples of the challenges encountered with respect to project constraints/criteria, methods maturity and flight clearance procedures. As validation of dynamic loading predictions is essential to aircraft qualification and certification, examples comparing predicted and flight measured data are presented.

Author

Aircraft Design; Fighter Aircraft; Dynamic Loads; Structural Design; Aircraft Structures; Aerodynamic Loads; Design Analysis

19970029342 Aerospatiale, Toulouse, France

The Ground Loads During Phases of Rolling: The Civilian and Military Specifications *Les Charges au Sol Lors des Phases de Roulage: Les Specifications Civiles et Militaires*

Sqeglia, G., Aerospatiale, France; Regis, O., Aerospatiale, France; Feb. 1997; 13p; In French; Also announced as 19970029334; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

This article presents a comparative study of American, English, and French standards and civil specifications (JAR/FAR) applied to conditions of ground roll. The results obtained with small bumps, the actual surfaces, and the work accomplished within the framework of civil regulations are presented. The influence of these different regulations is explained in taking for example a civilian turboprop certified for operations on semi-prepared surfaces.

Transl. by SCITRAN

Aircraft Design; Loads (Forces); Aircraft Specifications; Ground Tests; Aircraft Structures; Roll

19970029343 Lockheed Martin Tactical Aircraft Systems, Weapons System Design Center, Fort Worth, TX USA

Evolution of F-16 Loads and Requirements

Gibson, David H., Lockheed Martin Tactical Aircraft Systems, USA; Feb. 1997; 12p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

This article presents a review of the historical background of the growth of external loads and design requirements for the F-16 fighter aircraft. Several scenarios are recounted where analysis assumptions were determined to be inadequate and flight test or operational data presented situations not fully covered by design criteria. Changes in design requirements are discussed and suggestions for future aircraft design analyses are offered.
Author
Aircraft Design; F-16 Aircraft; Design Analysis; Flight Tests; Loads (Forces); Structural Design; Aircraft Structures

19970029345 Daimler-Benz Aerospace A.G., Munich, Germany
Influence of Thrust Vectoring System (TVS) on Structural Design Loads
Fuelhas, Konrad, Daimler-Benz Aerospace A.G., Germany; Neubauer, Martin, Daimler-Benz Aerospace A.G., Germany; Feb. 1997; 12p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The maneuverability and performance of modern fighter aircraft can be enhanced by a Thrust Vectoring System (TVS). This paper will show the benefits for the aircraft (e.g. Poststall) and identify the change in the structural design loads when a TVS will be adapted to an existing fighter aircraft. The requirement is to minimize structural changes under consideration of the benefits from the TVS for aircraft and performance. The capabilities and properties of new fighter aircraft to be designed initially including TVS will be touched on.
Author
Aircraft Design; Thrust Vector Control; Structural Design; Loads (Forces); Fighter Aircraft; Thrust; Maneuverability; Aircraft Performance

19970029346 British Aerospace Defence Ltd., Aerodynamics Dept., Preston, UK
Eurofighter 2000 Structural Design Criteria and Design Loading Assumptions
Watson, G. J., British Aerospace Defence Ltd., UK; Feb. 1997; 10p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

This paper provides an overview of the assumptions employed in the preparation of Design Loads for the Eurofighter 2000 aircraft. For loading purposes, a set of Design Criteria have been defined, which summarize the principal maneuver requirements for the aircraft. Additional assumptions on aircraft Control usage have been necessary to allow Design Loads to be defined without a detailed knowledge of the final standard of Flight Control System. The assumptions employed have been aimed at providing a robust structural design for the airframe, an aim which is now being validated through the Flight Clearance and Test activities on which the first Prototype aircraft are currently engaged.
Author
Aircraft Control; Structural Design Criteria; Aircraft Design; Aircraft Structures; Aircraft Maneuvers; Flight Control; Structural Design; Loads (Forces); Fighter Aircraft

19970029350 Lockheed Martin Tactical Defense Systems, Saint Paul, MN USA
COTS Joins the Military
Anderson, L., Lockheed Martin Tactical Defense Systems, USA; Stevens, R., Lockheed Martin Tactical Defense Systems, USA; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The complexity of today's military system has caused the priority of affordability to rise to an unprecedented level among system requirements. An increasing number of government and defense industry leaders are relying on commercial off-the-shelf (COTS) products with the associated economies of scale and use of non-developmental items (NDI) to meet this requirement. The affordability benefits of COTS and NDI for military systems are subject to several other factors. For example, as the need for products capable of operating in a hostile military environment increases, the number of products and vendors meeting these requirements decreases. ln addition, military systems, which traditionally have been expected to survive for long periods of time, are subjected to two commercial phenomena that occur simultaneously - product prices decrease over time while technology provides an increase in product performance. The latter factor results in a dichotomy summarized as parts obsolescence. This paper identifies additional military system issues and current commercial trends and postulates how these trends can be used to meet affordability requirements. The latter includes illustrated use of open system standards combined with pre-planned product improvement (P3I).
Author
Defense Industry; Dichotomies; Economy

19970030199 National Academy of Sciences - National Research Council, Panel on Structures, Washington, DC USA
Report of the Panel on Structures
Hyer, Michael W., Virginia Polytechnic Inst. and State Univ., USA; Venneri, Samuel L., NASA Langley Research Center, USA; Aeronautics Technology Possibilities for 2000: Report of a Workshop; 1984, pp. 71-98; In English; Also announced as 19970030196; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Over the last 50 years, aeronautical structures have evolved from the wood, fabric, and wire of low-speed biplanes to supersonic aircraft fabricated with advanced metallic and nonmetallic materials. The advances made in structures technology have had significant impact on aircraft design and performance. An example is the large weight reductions being realized from the utilization of composite materials for secondary and primary structures. However, structural advances have been evolutionary, not revolutionary. Through the year 2000, there are opportunities to obtain significant new advancements in structural technology. These advances could result in considerable performance and capability payoffs such as increased payload, range, speed, maneuverability, fuel efficiency, and safety through reductions in weight, increases in strength, and the ability to make structures pliable. Also, with new manufacturing processes it is possible that reductions in production costs will be realized. Some of the structural technology areas where future major advances could be made are adaptive structures, thermal structures, damage tolerant structures, propulsion system structures, and new structural concepts.
Derived from text
Structural Engineering; Structural Design; Aircraft Performance; Aircraft Design; Production Costs; Manufacturing; Durability

19970030204 National Academy of Sciences - National Research Council, Panel on Systems Integration, Washington, DC USA
Report of the Panel on Systems Integration
Sigalla, Armand, Boeing Commercial Airplane Co., USA; Maglieri, Dominic J., NASA Langley Research Center, USA; Aeronautics Technology Possibilities for 2000: Report of a Workshop; 1984, pp. 195-213; In English; Also announced as 19970030196; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Projections of technological advances to the year 2000 have suggested a number of possible conceptual types of air vehicles. For convenience, these have been grouped according to speed, increasing from below Mach 1 (including hovering flight) through various Mach ranges to orbital flight. The potential performance capabilities that could be realized for each of these types of aircraft provide exciting prospects for the years beyond 2000. It is clear that the greater design flexibilities provided by the projected technology advances will permit significant improvements in performance, economy, and safety and allow the design and development of aircraft systems that current technology will not support. In the following sections, each vehicle type is discussed, noting design features and significant advances. Where related aircraft exist, the significant economic and performance factors are compared. In addition, for each concept, the technology developments considered essential for the advanced concept are identified. The types of aircraft described are examples of what advances in the technology projected for the year 2000 could provide. They are by no means all that would be possible. The panel's views on the current state of knowledge of systems intergration as a discipline and the need for advancement in this area presented in the concluding section of this report.
Derived from text
Systems Integration; Economic Factors; Transonic Speed; Mach Number; Hovering

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19970028811 Air Force Inst. of Tech., Air Univ., Wright-Patterson AFB, OH USA
Automated Cockpit Technologies: Implications for Air Mobility Command Aircrews
Val le, Christopher R., Air Force Inst. of Tech., USA; Jan. 1997; 59p; In English
Report No.(s): AD-A326710; AFIT/GMO/LAC/97Y-12; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Air Force has purchased its first new generation of airlift aircraft with the acquisition of the C-17. More than just replacing the C-141 as the workhorse of the Air Force, the C-17 has also replaced part of the crew with inertial navigation systems, computers, and automation. The reliance on the automation of the C-17 demands a smooth interface between crew and automation, the crew must stay informed of the progress of the systems, and remain prepared to assume manual control should the automation fail. to accomplish this, the automation must be designed for ease of use and the crew must be trained to work in harmony with each other and the automation. Each aircraft manufacturer has a particular philosophy about how its aircraft are automated, and each aircraft operator has a philosophy about operating those aircraft. An understanding of these philosophies and the knowledge

of problems associated with automation are valuable tools for pilots. This paper will discuss those philosophies, including the philosophies of the design and operation of the C-17. Fortunately, civilian aviation has had over ten years of experience dealing with the many intricacies of these highly automated aircraft. Pilot reports and academic research have identified specific problems, or pitfalls associated with automated aircraft. This paper presents pitfalls to be avoided by Air Force operators.
DTIC
Cockpits; Human Factors Engineering; Automatic Pilots

19970029348 Northrop Grumman Corp., Military Aircraft Systems Div., Pico Rivera, CA USA
Advanced Avionics Architectures: Where are We Going?
Domae, T. P., Northrop Grumman Corp., USA; Logan, H. L., Northrop Grumman Corp., USA; Viney, J. E., Northrop Grumman Corp., USA; Advanced Architectures for Aerospace Mission Systems; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

We will explore the question of where avionics architectures are today, considering the Joint Strike Fighter and the evolution of open system approaches from the PAVE PACE and PAVE PILLAR programs of the 1980's. The recent work extends today's notions of a unified software and hardware approach to core processing and a common interconnect between architectural elements, not only to sensor or signal processing, but toward the apertures themselves and the system development environment. We shall take a broad view of the problem that includes RF electronics, interconnect, operating systems and application software development, processing hardware, and the system development environment itself. The architectural extensions discussed here are made in the context of the basic long term technology trends of more digital sensor processing and preprocessing, higher performance analog-to-digital converters, lightwave technology for both signal distribution and routing, and software structures that reduce development expense, while increasing the supportability and portability of applications software. Future RF electronics modules will be waveform independent and support multifunction apertures in a given spectrum for a selected bandwidth, with a strong impact on affordability since the RF sensors and their associated electronics correspond to some 70 percent of avionics fly-away cost. We will show how decoupling the explicit interactions of various system elements simplifies development and system integration by removing unwanted design dependencies and providing upgrade paths for cost effective technology insertion, with minimum system breakage. These techniques will be used to implement the principles of modularity, scale up, and ability to upgrade that have become part of the today's open system approaches and will be even more important in the future as the opposite poles of capability and affordability govern both new systems and upgrades. A coherent integrated architecture that promises more affordable development, implementation, and support is presented as the answer to the question, 'Where are we going?'
Author
Computer Systems Programs; Computer Programs; Bandwidth; Avionics; Architecture (Computers); Applications Programs (Computers); Modularity; Decoupling

19970029352 Alenia Aeronautica, Turin, Italy
Modular Avionics System Architecture Definition in the EUCLID Research and Technology Programme 4.1: Methodology and Results
Marchetto, A., Alenia Aeronautica, Italy; Jul. 1997; 12p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The European Cooperation for Long Term in Defense (EUCLID) Research and Technology Programme (RTP) 4.1 'Modular Avionic Harmonization Study' is a joint programme carried out by France, Germany, Italy, Netherlands, Spain and United Kingdom, aiming to harmonize modular avionic concepts among the aforementioned nations, thus preparing a common European basis for the future development of modular avionics platforms, taking as reference the 2005/2010 in service date time frame. The work has been developed through five work packages, dedicated respectively to General Requirements for Modular Avionics, System Architecture Definition and Risk Assessment, Technology Programmes, Modular Avionics Support Facilities, Identification of a Roadmap for Modular Avionics. This paper presents an overview of the methodology that has been adopted to come to the definition of a modular avionic system architecture which is capable to satisfy a defined set of functional requirements, in presence of technical constraints of various nature resulting from technology assessments carried out during the programme. The paper discusses the following subjects: The different functional areas to be covered by an avionic system tailored on an envelope of operational requirements. The different categories of functional/physical elements which compose the modular system. Those requirements, among the set of driving functional requirements taken as reference in the course of the study, whose impact has been so relevant to drive or condition the architectural study. Technical requirements and constraints associated to the physical elements having a direct impact on the system architecture model. The basic characteristics and an outline of the proposed architectural model, how it has proceeded from the above functional/technical requirements, and how it incorporates important fea-

tures, such as an adequate capability to tolerate faults by reconfiguration and to perform data fusion at various levels. Limits of the architectural study carried out.
Author
Functional Design Specifications; Architecture (Computers); Avionics

19970029353 Wright Lab., Avionics Directorate, Wright-Patterson AFB, OH USA
When Do Advanced Avionics Architectures Make Sense For Upgrading Aging Aircraft?
Krueger, C. H., Wright Lab., USA; Venner, R., Wright Lab., USA; Jul. 1997; 10p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

With the dramatic reduction in defense spending in NATO countries, it is quite clear that there will be few new military aircraft for perhaps many years. A consequence is that there will be widespread use of current aircraft to satisfy future military mission requirements. One of the most cost-effective means for improving the capability of a military aircraft to deal with new threats and mission requirements is to upgrade the performance of the avionics suite. However, current federated avionics subsystems are weapon-system unique, have limited capability and life and may not support new functional requirements. In addition, the cost of performance upgrades for federated avionic suites are prohibitive, particularly in terms of the budgets available. Integrated, modular avionics technologies offer substantial potential for improving the reliability and reducing the cost/weight volume per function for adding new functional capability. Integrated, modular avionics are normally considered for new aircraft, but there is some evidence that they may have potential in some circumstances for older aircraft as well. This paper examines several military aircraft applications and discusses the circumstances where the retrofit of an advanced avionics architecture may be preferred to more conventional approaches. The major consideration is cost per function. The paper will show that the advanced architecture is a clear winner as the number of functions is significant in terms of the level of integration required with other subsystems. It is very difficult to determine with even coarse precision the costs of various approaches, but certain trends are apparent. Not too surprisingly, the dominant acquisition cost is not the avionics equipment, but the cost of installing and integrating the equipment into the aircraft together with the cost of testing, documentation and training.
Author
Avionics; Cost Effectiveness; Functional Design Specifications; Military Operations; Support Systems; Weapon Systems

19970029354 Wright Lab., Avionics Directorate, Wright-Patterson AFB, OH USA
The Future of Avionics Architectures
Morgan, D. Reed, Wright Lab., USA; Jul. 1997; 14p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

A look into the future of avionic architectures over the next twenty years is presented by extrapolating past evolutionary trends, projecting future military needs and projecting the availability of advanced architectural building blocks. The basis for this forecast is drawn from the hypotheses that: (1) the physical and functional attributes of architectures evolve, even though the building block technologies often undergo revolutionary changes; hence, extrapolation of past architectural trends provides a good 'first cut' look at the future, (2) basic changes in architecture are driven by network bottlenecks resulting from the application of advanced technology building blocks that are used to improve situation awareness; hence an understanding of forces driving improvements in situation awareness and what devices future architects will have at their disposal helps frame the processing and interconnect requirements (and hence the architecture) and (3) cost containment, even cost reduction of avionics systems, will be the dominant driver for future architectures; hence, any form of physical or functional integration that reduces cost also helps define future architectures. Conclusions drawn from this paper are: (1) architecture changes resulting from avionics updates will continue to be evolutionary, with new building blocks and network designs 'grown onto' the existing infrastructure, (2) architectural extensions for retrofits will take the form of 'bridging' network interface circuitry that will interconnect advanced COTS-based networks and processors, (3) the drive for improved situation awareness will force architectures to increasingly support signal processor-based networks that will be dominated by several gigabit/second streaming data; as a result, switch-based, point-to-point links will be the primary means of system-level interconnections, with bus-based networks being used mostly for control and message passing at the backplane level, (4) for the first time, the application of new photonics-based building blocks to new avionics designs will eventually allow the avionics architect the design freedom to physically and functionally locate computing assets at space-available locations without performance penalty, (5) highly digital, 'functionally integrated, physically distributed' systems will emerge, with the co-habitation of RF analog and digital pre-processing, signal and data processing modules existing within the same module-based enclosure. A physically distributed, unified network will result, with a unified interconnect network across RF, IF, data and signal processing modules, (6) analog photonics will emerge to challenge RF electrical signal distribution, filtering and frequency conversion functions, (7) the digital boundary will move closer to the RF apertures; digital CNI (up to 2 Ghz) systems and a mostly digital-based radar warning and radar systems will eventually replace more costly analog

designs, X) within the next 15-20 years, a new 'fourth generation' architecture will emerge that will embody the features described above. The dominant feature of this projected architecture is the similar interconnect structure that both analog and digital avionics will assume. As a result of the increasing digitization of analog functions and the availability of high speed networks, the classical physical boundaries of avionics will almost vanish, (9) architectures will be driven and constrained by the mandate that designs be made open and commercial-based to the greatest extent possible. This trend will profoundly affect future architectures in that network protocols, processors and software operating systems will likely change with time. Coping with this changing environment will require the expanded use of design tools, descriptive design languages and programmable interfaces. Future architectures must be designed for change at the outset.
Author
Avionics; Architecture; Circuits; Data Processing; Digital Radar Systems; Digital Techniques; Frequency Converters; Functional Integration; Software Engineering; Protocol (Computers)

19970029355 British Aerospace Defence Ltd., Military Aircraft Div., Preston, UK
Technology Transparency in Future Modular Avionic Systems
Edwards, R. A., British Aerospace Defence Ltd., UK; Connan, C., Dassault Aviation, France; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Affordability is a key driver for future weapon systems, and it is generally accepted that integrated modular avionics (IMA) can make a major contribution to the reduction of acquisition and support costs. However, the technologies upon which IMA depends are evolving rapidly, and there is a danger that emerging IMA standards and systems under development will become obsolete over timescales which are short compared to military programme lifecycles. This paper suggests that steps can be taken to mitigate the impact of obsolescence on complex avionic systems by ensuring that technology transparency is established as a key architecture characteristic, and is tackled from the outset in standardization activities and in system design. The importance of technology transparency is a consequence of the rate of technology development in relation to the long system lifecycle for military projects, and the need for interchangeability and backwards compatibility of new building blocks in 'old' systems in order to reduce life cycle costs (LCC). Examples of how technology transparency can be achieved are given for the hardware, software and data networks domains. Key areas for long term 'open system' interface standards which support technology transparency are identified, based on information previously released from the Allied Standard Avionics Architecture Council (ASAAC) standardization program. The implications of system level issues (safety, security, qualification, etc.) and the drive to exploit Commercial Off The Shelf (COTS) technology are explored, and the need to consider technology transparency for system design tools is established. The main conclusion is that, whilst many regard technology transparency as the 'Holy Grail' of IMA, practical solutions are possible in a number of areas and must be pursued vigorously through programmes such as ASAAC if LCC benefits are to be maximized.
Author
Systems Engineering; Weapon Systems; Support Systems; Life Cycle Costs; Cost Reduction; Computer Programs; Avionics

19970029356 Bundesamt fuer Wehrtechnik und Beschaffung, Koblenz, Germany
Integrated Modular Avionics Architecture Concepts Demonstration
Potthaus, J., Bundesamt fuer Wehrtechnik und Beschaffung, Germany; Kloeckner, W., Elektroniksystem- und Logistik G.m.b.H., Germany; Sprang, I., Elektroniksystem- und Logistik G.m.b.H., Germany; White, C. G., Elektroniksystem- und Logistik G.m.b.H., Germany; Jul. 1997; 10p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper reports on the refinement, demonstration and validation of a number of key concepts for Integrated Modular Avionics (IMA), as performed under the IMA Demonstrator programme. For the communication network, software architecture, and fault management areas, selected aspects of the concepts were refined, and implemented on a demonstration platform. This platform, termed the IMA Demonstrator, is a tool for investigating and evaluating IMA issues, and has been constructed largely from commercial off the-shelf components. In the IMA Demonstrator, the communication network is implemented by a functional prototype of the Matrix Switched Network. The software architecture of the IMA Demonstrator includes functional prototypes of the communication system and the fault management system. The IMA Demonstrator and its functional prototypes have been used to validate the relevant IMA Concepts.
Author
Computer Systems Programs; Communication Networks; Avionics; Management Systems

19970029359 Daimler-Benz Aerospace A.G., Military Aircraft Div., Munich, Germany

Signature Avionics: Signature Optimised Operating of a Stealth Aircraft

Hurst, P., Daimler-Benz Aerospace A.G., Germany; Knappe, P., Daimler-Benz Aerospace A.G., Germany; Benninghofen, B., Daimler-Benz Aerospace A.G., Germany; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Stealth design is one design principle for next generation combat aircraft. The effort in this area have a long history at the Daimler-Benz Aerospace (Dasa), formerly MBB, e.g. the Lampyridae project in the early 80's. Operational studies have shown that the introduction of stealth design will increase the survivability of combat aircraft significantly, especially against airborne threats. Yet the effective use of critical signatures during a mission and the matching of tactics to stealth features require the development of an adapted avionics. This adapted avionics - signature avionics - will not compromise the stealth design, take direct advantage from the stealth characteristics, and utilize the stealth properties via an integrated tactical mission control. to transform this idea into an applicable format suited for the implementation in aircraft avionics systems, a functional breakdown in individual functions, prototyping and performance analysis of these functions, turns out to be necessary. The feasibility of this approach has been proven on the signature avionics function 'fly by signature' as an example.

Author

Reliability Analysis; Fighter Aircraft; Avionics

19970029360 Naval Air Warfare Center, Aircraft Div., Warminster, PA USA

A Multiservice Switch for Advanced Avionics Data Networks

Rosen, W. A., Naval Air Warfare Center, USA; Phipps, W. A., Florida Agricultural and Mechanical Univ., USA; George, A. D., Florida Agricultural and Mechanical Univ., USA; Turner, D. D., Naval Air Warfare Center, USA; Gershman, V., Naval Air Warfare Center, USA; Birmingham, M. P., Naval Air Warfare Center, USA; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

With knowledge of persistent data communication traffic patterns offered to an avionics data network, modifications to the routing through the network can be made to improve total throughput and bound the latency of packets. The Multiservice Switch (MSS) is such a route-optimizing switch for streaming sensor data. The MSS has two switching fabrics. packet switching and circuit switching. The packet-switching fabric routes small control and data packets between switch ports. The circuit-switching fabric uses a crossbar to physically connect ringlets, which reduces the workload on the packet-switching fabric long data streams between the ports. An implementation of the MSS is described which uses commercial-off-the-shelf (COTS) components. A simulation model was developed to show the benefits of the MSS under standard avionics workloads. The results of the MSS indicate distinct advantages in terms of performance, price, and power consumption over other conventional switch and network topology designs.

Author

Switching Circuits; Topology; Switches; Routes; Packets (Communication); Packet Switching; Data Transmission; Data Flow Analysis; Computer Networks; Avionics

19970029361 National Aerospace Lab., Amsterdam, Netherlands

Simulation of a Cell Switched Network for the Control of a Switch Matrix in a High-Speed Avionics Network

Aupers, David A., National Aerospace Lab., Netherlands; Heerink, Gerald J., National Aerospace Lab., Netherlands; Wellink, Steven, National Aerospace Lab., Netherlands; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper describes the research and experiments carried out by the National Aerospace Laboratory (NLR) in the field of high-speed interconnection systems for modular avionics. The research has been carried out in the EUCLID/RTP4.1 framework. The avionics network that was modelled and simulated was an optical switch matrix under control of a cell switched network. The optical switch matrix offers the avionics system circuit switched, uni-directional, point-to-point connections. A bandwidth of 2 Gbps is projected. The main purpose of the matrix is to connect sensors producing high data rates, such as an attack radar in fighter aircraft, with the core avionics processing cluster. The cell switched network - in this case Asynchronous Transfer Mode (ATM) - controls the optical switch matrix and provides data transfer at lower data rates, file transfer, and status messages. The simulation model operated ATM at 149 and 622 Mbps. The primary objective of our research was to assess ATM as a data link layer for a control and message network in an avionics data network. The computer-based tool to model the network was SES/Workbench.

Author

Asynchronous Transfer Mode; Avionics; Bandwidth; Computer Networks; Data Links; Network Control; Switching Circuits

19970029364 Hughes Aircraft Co., Los Angeles, CA USA

Integrated Processing

Farmer, Roy, Hughes Aircraft Co., USA; Robinson, Thomas H., Hughes Aircraft Co., USA; Trujillo, Edward, Hughes Aircraft Co., USA; Jul. 1997; 10p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

A review of the modular avionics concepts is presented in light of DOD's mandate to change the military's acquisition process and the recent delivery of advanced modular processing systems developed to meet the demands of the next generation avionics. Future trends - in avionics are discussed along with how this will impact the modular standards just now being implemented. Modular avionics is the most dominant feature of our advanced avionics systems. Initially mandated because of the projected cost advantages, modular avionics also provides significant performance potential. Modular avionics is characterized by configurations that partition the system into building blocks that feature integration, modularity, and commonality. The main focus of these concepts is initially being applied to the digital core avionics for which the F-22 Common Integrated Processor is a powerful and innovative realization. The USAF PAVE PACE and NASA programs extended the current concepts further and the initiatives to integrate commercial-off-the-shelf (COTS) technology has fostered innovative solutions to improve increased availability at reduced costs. Functions within the aircraft will become more integrated requiring innovative approaches to the management of the computer resources and distribution of information.

Author

NASA Programs; Modularity; Cost Reduction; Avionics; Computers

19970029365 Daimler-Benz Aerospace A.G., Sensor Systems, Ulm, Germany

A Modular Scaleable Signal Processor Architecture for Radar and EW Applications

Keller, H. P., Daimler-Benz Aerospace A.G., Germany; Rabel, R., Daimler-Benz Aerospace A.G., Germany; Schmitt, K.-P., Daimler-Benz Aerospace A.G., Germany; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Daimler-Benz Aerospace, Ulm has developed the Advanced Programmable Signal Processor (APSP), a modular, scaleable and programmable multi-Gigaflop machine based on studies sponsored by GMOD. The modular architecture allows an easy tailoring to quite different requirements in signal processing and pattern recognition for Radar, Sonar, Electro-optical sensor applications, e.g. from small non-coherent radar and EW systems up to sophisticated airborne multimode pulse doppler radars or complex ground or ship based multichannels radars. From an architectural point of view, the APSP comprises clusters of single chip floating point processors (Texas Instruments TMS320C3x [1] digital signal processor which can perform 32-bit floating point calculations at a 60 Megaflop rate), special partially programmable modules (based upon off-the-shelf VLSI-chips), multipurpose memory modules and multipurpose interface modules. The APSP comes with comprehensive Software and Tools including the real time multiprocessor operating system APOS. The modularity and scalability in Hardware and Software offers the possibility to tailor the signal processor performance to the application, while preserving options for growth potential. Furthermore modifications in the processing algorithms are done via software changes, without costly hardware redesign. This article focuses the major aspects of the APSP in Hardware, Operating System and Software Tools and shows the implementation of a small and a high performance application.

Author

Modularity; Algorithms; Coherent Radar; Computer Programs; Digital Systems; Doppler Radar; Electro-Optics; Radar Detection; Signal Analyzers

19970029373 Elektroniksystem- und Logistik G.m.b.H., Avionics-Fixed Wing Aircraft, Munich, Germany

Sensor Fusion for Modern Fighter Aircraft

Taubenberger, K., Elektroniksystem- und Logistik G.m.b.H., Germany; Ziegler, J., Daimler-Benz Aerospace A.G., Germany; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Sensor Fusion has become important for fighter aircraft in order to improve the air picture with respect to the displayed area of all sensors, the precision of target's kinematic data, the confidence in the target's identity, and to support the management of the sensors. The paper investigates system architectures of existing and future sensors. Based on a Bayesian fusion approach, the benefits and constrains of data throughput, accuracy and track consistency is shown. The results of simulation runs with radar, IR and ESM sensor models together with a data link network are presented.

Author

Bayes Theorem; Fighter Aircraft; Multisensor Fusion; Images; Data Links

19970029374 Wright Lab., Wright-Patterson AFB, OH USA

Impact of COTS on Military Avionics Architectures

Carbonell, Juan, Wright Lab., USA; Ostgaard, John, Wright Lab., USA; Jul. 1997; 6p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The Department of Defense is being driven to use Commercial Off-the-Shelf (COTS) hardware and software in order to reduce the overly complex and unnecessary practices of using military standards and specifications while reducing costs. There are a variety of issues related to the use of COTS hardware and software components in military avionics systems that have an impact in the architectures. Avionics packaging, cooling, networks, processors, and software languages are just a sample of the areas affected by the use of COTS. A number of steps must be taken by weapon systems managers to ensure they have a strategy in place to meet the challenges brought on by COTS technologies.

Author

Computer Programs; Avionics; Defense Program; Systems Management; Weapon Systems

19970029375 Daimler-Benz Aerospace A.G., Military Aircraft Div., Munich, Germany

An Approach Towards Integration of a Modular Core Avionics System Kernel

Grasshoff, M., Daimler-Benz Aerospace A.G., Germany; Foerster, M., Daimler-Benz Inter Services, Germany; Jul. 1997; 14p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Daimler-Benz Aerospace (Dasa) Military Aircraft Division has set up an experimental avionic system with modular structure using VMEbus based hardware components and a commercially available operating system (OS) as common OS. Since commercially available realtime OS's do not fulfill the requirements for future avionic systems, System Management Software (SYMS) has been developed. SYMS enables the communication between different processor modules and their co-operation. This is the presupposition for fault management and reconfiguration management within the whole core system. The reconfigurability of the experimental system has been demonstrated. The source code of SYMS has been fully written in Ada. Small sized interfaces to the hardware and to the OS support easy adaptation to different environments of hardware and or OS. Applications of the whole core system are controlled separately by SYMS Tables (Blueprints). The approach supports developing portable and reusable application software. The flexibility of SYMS enables the demonstration of different standards and their capabilities within different integrated systems. Currently, this work is of interest in view of the Allied Standard Avionics Architecture Council (ASAAC) demonstration programme, planned for the ASAAC Phase 2. Flight capable derivatives of the experimental system can be used in different experimental flight programmes. Information about a modular computer to be flown within an experimental flight programme is presented.

Author

Ada (Programming Language); Applications Programs (Computers); Avionics; Computer Programs; Kernel Functions; Real Time Operation; Systems Management

19970029376 Daimler-Benz Aerospace A.G., Hamburg, Germany

Low-Level Flight Capability of a Future Military Transport Aircraft Based on Commercial Avionics

Kricke, K. Dieter, Daimler-Benz Aerospace A.G., Germany; Schaefer, Dirk, Daimler-Benz Aerospace A.G., Germany; Jul. 1997; 10p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

There is a need for a new military transport aircraft, which can cope with the operational requirements to improve the current air transport forces of the European countries to satisfy tactical, logistic and future operations, at the beginning of the next century. Significant requirements, which relate to the avionics and mission systems, are for instance: low-level flight capability and board-autonomous approach and landing capability enabling adverse weather operations by day and night. This paper describes a system concept for low-level flight capability based on commercial avionics as used in AIRBUS aircraft. First, the essential functions and features of the flight control and flight guidance system are highlighted. Then, the additional functions and system elements related to controls/displays and operational modes, which are required for low-level flight, are discussed. Finally, the first results of a demonstration and pilot evaluation performed in the flight simulator a DAIMLER-BENZ AEROSPACE AIRBUS in Hamburg are presented. The investigations described in this paper have been performed within the context of technology studies, which are partially sponsored by the German Ministry of Defence.

Author

Air Transportation; Avionics; Display Devices; Flight Control; Flight Simulators; Transport Aircraft

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.

19970029263 Michigan Univ., Div. of Research Development and Administration, Ann Arbor, MI USA
Effects of Mistuning on the Forced Response of Turbomachinery Rotors ***Final Report***
Pierre, Christophe, Michigan Univ., USA; Dec. 29, 1994; 11p; In English
Contract(s)/Grant(s): NAG3-1163
Report No.(s): NASA-CR-205484; NAS 1.26:205484; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The basic purpose of this research has been to develop a fundamental understanding of the effects of blade-to-blade dissimilarities, or mistuning, on the dynamics of nearly cyclic bladed-disk assemblies. This topic is of importance as mistuning has been shown to increase the forced response amplitudes of some blades significantly, and even to lead to blade failure. Furthermore, the current trend toward high performance propulsion turbomachinery designed for finite service life demands an accurate prediction of system performance and dynamics at the design stage. This objective has been achieved by carrying out the following tasks. First, the investigation of the free and forced responses of representative, yet sufficiently simple blade assembly models that capture all the important characteristics of typical turbomachinery rotors. Second, the development of computational methods that predict the effects of mistuning in a systematic and reliable way, along with the development of a systematic reduced-order modeling procedure for mistuned bladed disks. Third, the application of these findings and the tools developed to an industrial rotor, namely the first stage of turbine blades of the oxidizer turbopump in the space shuttle main rocket engine (SSME). The research supported by NASA has led to the development of a coherent theory for mistuned blade assemblies. The further implementation of these computational tools into the forced response prediction system currently under development in the Structural Dynamics Branch-FREPS-would enable the designer and the analyst to: (1) identify types of blade assemblies highly sensitive to mistuning in various frequency and other parameter ranges and (2) characterize mistuning effects on their forced response by predicting true response amplitudes and fatigue life estimates.
Author
Turbine Blades; Turbomachinery; Rotors; Mistuning (Turbomachinery); Rotor Blades (Turbomachinery); Computer Programs; Dynamic Response

19970029546
Effects of incorporating a cone swirler into a side-inlet ducted ramrocket
Wu, Pei-Kuan, Taitech, Inc, USA; Chen, Ming-Hsiung; Baurle, Robert A.; Eakins, William E.; Chen, Tzong H.; Nejad, Abdollah S.; Journal of Propulsion and Power; January 1997; ISSN 0748-4658; vol. 13, no. 1, pp. 162-166; In English; Copyright; Avail: Issuing Activity

A feasible cone swirler design for a side-inlet ducted ramrocket combustor has been demonstrated and its advantages illustrated using the KIVA3 program. Studies of the nonreacting flowfield indicate that the cone swirler not only improves the flow pattern, but also enhances the flow swirl in the combustor.
Author (EI)
Combustion Chambers; Computerized Simulation; Flame Holders; Ramjet Engines; Side Inlets; Spacecraft Propulsion; Vortices

19970030195 Los Alamos National Lab., NM USA
Advanced aircraft ignition CRADA ***Final Report***
Early, J. W., Los Alamos National Lab., USA; [1997]; 34p; In English
Contract(s)/Grant(s): W-7405-eng-36
Report No.(s): LA-CRADA-97-2; DE97-003447; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Conventional commercial and military turbo-jet aircraft engines use capacitive discharge ignition systems to initiate fuel combustion. The fuel-rich conditions required to ensure engine re-ignition during flight yield less than optimal engine performance, which in turn reduces fuel economy and generates considerable pollution in the exhaust. Los Alamos investigated two approaches to advanced ignition: laser based and microwave based. The laser based approach is fuel ignition via laser-spark breakdown and via photo-dissociation of fuel hydrocarbons and oxygen. The microwave approach involves modeling, and if necessary

redesigning, a combustor shape to form a low-Q microwave cavity, which will ensure microwave breakdown of the air/fuel mixture just ahead of the nozzle with or without a catalyst coating. This approach will also conduct radio-frequency (RF) heating of ceramic elements that have large loss tangents. Replacing conventional systems with either of these two new systems should yield combustion in leaner jet fuel/air mixtures. As a result, the aircraft would operate with (1) considerable less exhaust pollution, (2) lower engine maintenance, and (3) significantly higher fuel economy.
DOE
Aircraft Engines; Fuel Combustion; Ignition Systems; Hydrocarbons; Jet Engine Fuels; Combustion Chambers; Oxygen

19970030198 National Academy of Sciences - National Research Council, Panel on Propulsion, Washington, DC USA
Report of the Panel on Propulsion
Kerrebrock, Jack L., Massachusetts Inst. of Tech., USA; Poferl, David J., NASA Lewis Research Center, USA; Aeronautics Technology Possibilities for 2000: Report of a Workshop; 1984, pp. 47-69; In English; Also announced as 19970030196; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Propulsion, while conventionally included on the list of important aeronautical disciplines along with aerodynamics, structures, etc., is in itself a systems endeavor, analogous to the engineering of the entire vehicle; indeed propulsion encompasses important aspects of all the other disciplines. In recognition of this fact, the panel focused its discussion on those aspects of the key disciplines that are especially or uniquely important to propulsion. From the initial development of the airplane, the propulsion system has been recognized as one of the pacing technologies. It is perhaps because of the technological disparity between the reciprocating engine and the primitive airframe that the two remained relatively and separate, were developed somewhat independently, usually by different organizations. In recent years, the maturing of the gas turbine power plant and the advance in high-speed airframes have rendered this separation somewhat artificial. The power plant and the airframe now share common structural and aerodynamic elements; as the flight Mach number rises, the degree of interaction increases. by the year 2000, this interdependence will have increased in many respects to a point where independent design may not be practical or possible. During the period since the initiation of the aircraft gas turbine, the solid propellant rocket and the liquid propellant rocket, a vast array of other novel engines have been studied, covering the full spectrum of flight conditions from low subsonic to hypersonic and transatmospheric flight. In each instance, performance limits have been investigated under the assumption that current technology or reasonably foreseeable technology would be available for their development. Among the extensive list of advanced, high-performance concepts and cycles examined are the hypersonic ramjet, the variable cycle, runway-to-orbit airbreathing engine, the ram rocket (airbreathing and rich solid propellant rocket), and the air turborocket. At various times, these systems have come relatively close to meriting development and application. In many instances, limitations of materials and technologies curtailed development. As important and with almost equal frequency, the lack of commercial or military utility of the concept precluded the necessary funding. It is instructive to note that two former items on this list, the turbofan (bypass engine) and the high-speed turboprop, are respectively a mainstay engine and a promising development. In the case of the turbofan, its full potential could not be realized until turbine cooling technology had been developed and new materials developed to permit the construction of transonic fans. In the case of the highspeed turbopropeller engine, not only were the material and turbine technologies needed, but, in addition, the rise in fuel costs provided the impetus to take advantage of its favorable fuel consumption characteristic. As the basic technologies progress and as new missions become attractive, the engines in the foregoing list become candidates for new feasibility studies and further technology development. At the present time, the ram rocket is the prime contender to augment the range of small missiles. of interest also is the hypersonic ram jet and its logical extension, the runway-to-orbit airbreathing engine. Much of this report deals with the development of current or near-future power plant concepts. First, the motivating factors for aeronautical propulsion research are reviewed as a reminder of the importance of continued effort in a field that has often been characterized as mature. Next, technical areas are discussed in which the panel feels additional research effort is warranted and would lead to the realization of the technological potentials between now and the year 2000. Under these guidelines, new cycles (e.g., isothermal energy exchange) were not considered by the panel. Finally, although facility requirements were not a prime consideration in the current projections, the panel believes that the increasing complexity of propulsion systems; the need for more refined interaction between propulsion system, airframe, and controls; and increasing operation in adverse weather will require test capabilities beyond those now available (see appendix). Enhanced test capability is needed in the areas of propulsion airframe integration and in largescale icing research with proper concurrent treatment of altitude, temperature, and speed.
Derived from text
Propulsion System Configurations; Propulsion System Performance; Aerodynamics; Energy Transfer; Fuel Consumption; Liquid Rocket Propellants; Turbofan Engines; Turborocket Engines; Ramjet Engines; High Speed

08
AIRCRAFT STABILITY AND CONTROL

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

19970028723 North Carolina Agricultural and Technical State Univ., NASA Center of Research Excellence, Greensboro, NC USA

Supplemental Control for Aircraft Riding Qualities

Williams, Rolanda S., North Carolina Agricultural and Technical State Univ., USA; Ashokkumar, C. R., North Carolina Agricultural and Technical State Univ., USA; Homaifar, Abdollah, North Carolina Agricultural and Technical State Univ., USA; The First National Student Conference: NASA University Research Centers at Minority Institutions; 1997, pp. 370-373; In English; Also announced as 19970028662

Contract(s)/Grant(s): NAGw-2924; Copyright Waived (NASA); Avail: CASI; A01, Hardcopy; A04, Microfiche

The concept of preview control has been applied and proven to be successful in the automotive vehicle. These same concepts are now applied to an aircraft under the assumption that exogenous inputs (wind gust, turbulence, etc.) can be measured. A supplemental control law for surface deflection is designed to compensate for the loss in performance in the presence of atmospheric disturbances. Fuzzy logic control is employed to handle the nonlinear, time varying characteristics of the disturbance. A methodology to tune the outer loop control parameters is presented.

Author

Fuzzy Systems; Control Theory; Aircraft Design; Motor Vehicles

19970028724 North Carolina Agricultural and Technical State Univ., Greensboro, NC USA

Aircraft Pitch Control With Fixed Order LQ Compensators

Green, James, North Carolina Agricultural and Technical State Univ., USA; Ashokkumar, C. R., North Carolina Agricultural and Technical State Univ., USA; Homaifar, Abdollah, North Carolina Agricultural and Technical State Univ., USA; The First National Student Conference: NASA University Research Centers at Minority Institutions; 1997, pp. 374-376; In English; Also announced as 19970028662

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This paper considers a given set of fixed order compensators for aircraft pitch control problem. by augmenting compensator variables to the original state equations of the aircraft, a new dynamic model is considered to seek a LQ controller. While the fixed order compensators can achieve a set of desired poles in a specified region, LQ formulation provides the inherent robustness properties. The time response for ride quality is significantly improved with a set of dynamic compensators.

Author

Aircraft Control; Controllers; Compensators; Pitch; Robustness (Mathematics); Dynamic Models; Aircraft Models

19970028726 Florida Agricultural and Mechanical Univ., Center for Nonlinear and Nonequilibrium Aeroscience, Tallahassee, FL USA

Multi-Axis Fluidic Thrust Vectoring of a Supersonic Jet Using Counterflow

Barber, Edward L., Florida Agricultural and Mechanical Univ., USA; Alvi, Farrukh, Florida Agricultural and Mechanical Univ., USA; Krothapalli, Anjanevulu, Florida Agricultural and Mechanical Univ., USA; The First National Student Conference: NASA University Research Centers at Minority Institutions; 1997, pp. 386-384; In English; Also announced as 19970028662

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The most common techniques currently used to efficiently vector supersonic jets require external flaps and or pivoting devices. Fluidic thrust vectoring using counterflow eliminates the need for such complex hardware. Thus, the promise of decreases in both weight and drag as well as increased maneuverability makes this technique an attractive alternative. This technique has been successfully employed to achieve single axis fluidic thrust vectoring of a Mach 2 rectangular jet. to better compete with contemporary systems the current study extends this technique to multi-axis thrust vectoring of a Mach 2 diamond-shaped jet by applying counterflow to one of its four sides. to evaluate the performance of this technique the Planar Laser Scattering (PLS) technique is used to show the continuous vectoring of the diamond jet up to 20 degrees. Also, cross-stream PLS images are acquired to show the vectoring can be achieved off all four surfaces of the diamond jet.

Author

Thrust Vector Control; Supersonic Jet Flow; Counterflow; Drag; Gas Jets; Flapping; Supersonic Speed

19970028798 California Inst. of Tech., Mechanical Engineering Lab., Pasadena, CA USA

Nonlinear Control of Mechanical Systems in the Presence of Magnitude and Rate Saturation ***Annual Report, 1 Jun. 1996 - 31 May 1997***

Murray, Richard M., California Inst. of Tech., USA; Jun. 13, 1997; 3p; In English

Contract(s)/Grant(s): N00014-96-I-0804

Report No.(s): AD-A326451; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This report describes recent analytical and experimental results on nonlinear control of systems with simultaneous magnitude and rate saturations.

DTIC

Flight Control; Nonlinear Systems

19970029201 Queen Mary and Westfield Coll., London, UK

Requirements Analysis of Real-Time Control Systems Using PVS

Dutertre, Bruno, Queen Mary and Westfield Coll., UK; Sravridou, Victoria, Queen Mary and Westfield Coll., UK; Fourth NASA Langley Formal Methods Workshop; Sep. 1997, pp. 65-85; In English; Also announced as 19970029195

Contract(s)/Grant(s): GR/H11471; DTI Proj. IED/1/9013; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper presents a practical application of the Prototype Verification System (PVS) theorem prover involving requirements analysis of real-time control systems. This work was conducted within the Safe FM project and relied on a real world avionics case study. We show how PVS was used to formalize the software requirements for the system and to verify safety-related properties. We also present the main result of the experiment. We give an overview of PVS libraries which were developed after the case study experiment and are intended to facilitate the specification and verification of similar systems.

Author

Computer Programming; Real Time Operation; Software Reliability; Program Verification (Computers); Data Acquisition

19970029203 Naval Research Lab., Center for High Assurance Computer Systems, Washington, DC USA

Applying the SCR Requirements Method to a Simple Autopilot

Bharadwaj, Ramesh, Naval Research Lab., USA; Heitmeyer, Constance, Naval Research Lab., USA; Fourth NASA Langley Formal Methods Workshop; Sep. 1997, pp. 87-101; In English; Also announced as 19970029195; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Although formal methods for developing computer systems have been available for more than decade, few have had significant impact in practice. A major barrier to their use is that developers find formal methods difficult to understand and apply. One exception is a formal method called Science Concept Review (SCR) for specifying computer system requirements which, due to its easy-to-use tabular notation and demonstrated scalability, has achieved some success in industry. to demonstrate and evaluate the SCR method and tools, we recently used SCR to specify the requirements of a simplified mode control panel for the Boeing 737 autopilot. This paper presents the SC requirements specification cation of the autopilot, outlines the process we used to create the SCR specification from a prose description, and discusses the problems and questions that arose in developing the specification. Formalizing and analyzing the requirements specification in SCR uncovered a number of problems with the original prose description, such as incorrect assumptions about the environment, its completeness, and inconsistency. The paper also introduces a new tubular format we found useful in understanding and analyzing the required behavior of the autopilot. Finally, the paper compares the SCR approach to requirements with that of Butler who uses the Prototype Verification System (PVS) language and prover to represent and analyze the autopilot requirements.

Author

Computer Systems Programs; Formalism; Software Engineering; Technology Transfer; Automatic Pilots

19970029339 NASA Langley Research Center, Hampton, VA USA

A Comparison of Pressure Measurements Between a Full-Scale and a 1/16-Scale F/A-18 Twin Tail During Buffet

Moses, Robert W., NASA Langley Research Center, USA; Pendleton, Ed, Wright Lab., USA; Feb. 1997; 12p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

In 1993, tail buffet tests were performed on a full-scale, production model F/A-18 in the 80-by-120 Foot Wind Tunnel at NASA Ames Research Center. Steady and unsteady pressures were recorded on both sides of the starboard vertical tail for an angle of attack range of 20 to 40 degrees and at a sideslip range of -16 to 16 degrees at freestream velocities up to 100 knots (Mach 0.15, Reynolds number 1.23 x 10(exp 7)). The aircraft was equipped with removable leading edge extension (LEX) fences that are used in flight to reduce tail buffet loads. In 1995, tail buffet tests were performed on a 1/6-scale F-18 A/B model in the Transonic Dynamics Tunnel (TDT) at NASA Langley Research Center. Steady and unsteady pressures were recorded on both sides of both

vertical tails for an angle-of-attack range of 7 to 37 degrees at freestream velocities up to 65 knots (Mach 0.10). Comparisons of steady and unsteady pressures and root bending moments are presented for these wind-tunnel models for selected test cases. Representative pressure and root bending moment power spectra are also discussed, as are selected pressure cross-spectral densities. Author

Pressure Measurement; Tail Assemblies; Buffeting; Wind Tunnel Models; Wind Tunnel Tests; Free Flow; Aerodynamic Loads; Scale Models; Steady Flow; Bending Moments; F-18 Aircraft; Unsteady Flow; Full Scale Tests

19970029344 Daimler-Benz Aerospace A.G., Structural Dynamics, Loads Dept., Hamburg, Germany

Impact of Electronic Flight Control System (EFCS) Failure Cases on Structural Design Loads

Besch, H.-M., Daimler-Benz Aerospace A.G., Germany; Giesseler, H.-G., Daimler-Benz Aerospace A.G., Germany; Schuller, J., Daimler-Benz Aerospace A.G., Germany; Feb. 1997; 10p; In English; Also announced as 19970029334; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

For structural design loads, the most relevant benefits of the advent of fly-by-wire and digital flight control systems are drawn from more sophisticated control of the aircraft and from the flight envelope protection functions. In parallel, rarely recognized even by the engineering community, the number of failure cases to be considered in A/C design is significantly increasing due to the growing complexity of the systems, eroding the aforementioned benefits. The monitoring system, designed to detect and to trigger removal of failure cases, can ease but not nullify the impact of failure cases on loads. Experience gained in the structural design of an A/C with fly-by-wire and digital flight control system is summarized, highlighting the necessity to cover system failures in calculating structural design loads. The current requirements for structural design of EFCS A/C are explained. by giving several examples of system failures of the new EFCS technology, it will be demonstrated how the requirements are met, whereby the influence on structural loads is especially emphasized. Generic system-failure cases (software/ hardware) having an influence on structural loads, are runaway, jamming and oscillation of control surface(s), the latter we call Oscillatory Failure Cases (OFC). OFC's cause significant component loads and can cause resonance phenomena which may generate excessive loads for poorly damped rigid body and flexible modes. This motivated the research programme Oscillatory Failure Case Identification System (OFIS) which, as a future component of the common Monitoring Systems, aims at detection of OFC's in time. We describe the current status of OFIS that exploits the specific properties of OFC for detection enhancement. Furthermore, by investigating the inverse effect, namely, that structure loads have an influence on system layout (or modification), this presentation will underline the necessity, mentioned above, of co-operation between all disciplines in modern aircraft design.
Author

Aircraft Control; Fly by Wire Control; Aircraft Design; System Failures; Structural Design; Aircraft Structures; Electronic Control; Loads (Forces)

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.

19970028875 Naval Surface Warfare Center, Systems Research and Technology Dept., Dahlgren, VA USA

Electromagnetic Remote Sensing for Airfield Assessment ***Final Report***

Swanson, Nancy, Naval Surface Warfare Center, USA; Irwin, Victoria, Naval Surface Warfare Center, USA; Marchette, David, Naval Surface Warfare Center, USA; Jan. 1997; 74p; In English

Report No.(s): AD-A327214; NSWCDD/TR-97/3; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The subject of this report is a study of current state of the art electrooptical systems used in remote sensing. Various passive and active imaging systems were analyzed for application to remote sensing of airfields. Descriptions of systems are given. The purpose was to determine an effective standoff sensing of the safety of remote airfields, especially when hostilities are underway. Criteria of interest were type of material (including differences in material, such as patches), delamination, cracks, holes, spalls, debris, surface roughness (large scale, such as trenches) and subsurface voids. Detailed results are included, supplemented with illustrations, as well as a summary of findings. The conclusion was that a combination of imaging systems is necessary to detect all of the defects. Recommendations include that the thermal imaging system, which yielded the most information, be further studied for this purpose. Enhancements to the thermal system were also recommended. Further study was recommended to determine

if the thermal system can distinguish runway material (asphalt, concrete, etc.) based on knowledge of material properties (emissivity, thermal conductivity, and heat capacity) and ambient temperature.
DTIC
Remote Sensors; Remote Sensing; Electro-Optics; Airports; Imaging Techniques; Black Body Radiation; Runways

19970028952 Army Aeromedical Research Lab., Aircrew Health and Performance Div., Fort Rucker, AL USA
An Inexpensive Portable Desktop Flight Simulation Task ***Final Report***
Crowley, John S., Army Aeromedical Research Lab., USA; Caldwell, John A., Army Aeromedical Research Lab., USA; Caldwell, J. L., Army Aeromedical Research Lab., USA; Earheart, Scott, Army Aeromedical Research Lab., USA; Tibbetts, Cindy, Army Aeromedical Research Lab., USA; May 1997; 30p; In English
Contract(s)/Grant(s): DA Proj. 3M1-62787-A-879
Report No.(s): AD-A327274; USAARL-97-19; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
A modified recreational flight simulation was tested as part of two recent studies examining the effects of Dexedrine on sleep deprived aviators. Software and controls for this task cost under $250. Six male and five female UH-60 pilots were sleep deprived for 40 hours twice in a double-blind repeated measures study comparing 10 mg Dexedrine (x3 doses) to placebo. Every 4 hours, subjects flew the profile and were scored on their speed and accuracy of flying a simulated light fixed-wing aircraft through 22 gates under varying wind conditions. In the males, a drug x session interaction ($p = 0.0361$) was due to variability with placebo but not Dexedrine. An auditory reaction time secondary task was added to the female pilots' workload resulting in a consistent (but not statistically significant) trend toward worse performance in the placebo condition. The drawbacks of this crude measure of flight performance must be weighed against the costs and feasibility of high fidelity flight simulation or in-flight research. Detailed task design specifications are provided.
DTIC
Sleep Deprivation; Flight Simulation; Pilot Performance; Physiological Effects; Physiological Tests

19970029162 Advisory Group for Aerospace Research and Development, Fluid Dynamics Panel, Neuilly-Sur-Seine, France
Aerodynamics of Wind Tunnel Circuits and their Components ***L'Aerodynamique des Circuits des Souffleries et de Leurs Composants***
Aerodynamics of Wind Tunnel Circuits and their Components; Jun. 1997; 446p; In English; 79th; Fluid Dynamics Panel Symposium, 30 Sep. - 3 Oct. 1996, Moscow, Russia; Sponsored by Advisory Group for Aerospace Research and Development, France; Also announced as 19970029163 through 19970029194
Report No.(s): AGARD-CP-585; ISBN-92-836-0042-8; Copyright Waived; Avail: CASI; A19, Hardcopy; A04, Microfiche
The aim of this Symposium was to gather and review both current knowledge and ongoing research on the aerodynamic design and evaluation of ground test facilities, focusing primarily on wind tunnels, in order to provide to the designers of experimental facilities an opportunity to exchange information, ideas, and visions. Shrinking budgets for new facilities have led to fewer facilities being developed and longer development times, which have in turn led to less opportunity for advances in the state-of-the-art and for the retention of the experts needed for the design of good experimental facilities. The normal overriding user objectives, when conducting almost any kind of wind-tunnel test, are obtaining reliable and meaningful data in a timely and cost-effective manner. Principal requirements for obtaining reliable and meaningful data are an adequate Reynolds number, representative or satisfactory tunnel flow quality, and the avoidance of tunnel wall and support system effects. Factors which are important in satisfying the timeliness and cost effectiveness requirements include minimizing the time required for model installation and configuration changes, utilization of efficient data gathering systems, and the ability to use rapid techniques to account for tunnel wall and support system interference effects. Since the aerodynamic design of wind-tunnel circuits has a fundamental first order effect on tunnel flow quality, tunnel wall and support interference effects, and on tunnel construction costs, the adequacy of the circuit design is of crucial importance in meeting the user's objectives. It should be noted that this was the first AGARD Symposium held in Russia, and that 50% of the papers were by Russian authors. Much information was shared by those who are involved in developing, operating, and utilizing experimental ground test facilities.
Author
Aerodynamic Interference; Circuits; Wind Tunnel Tests; Support Systems; Support Interference; Reynolds Number

19970029163 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia
Historic Review of the Creation and Improvement of Aerodynamic Test Facilities at TsAGI
Bedrzhitsky, E. I., Tsentralni Aerogidrodinamicheskii Inst., Russia; Roukavets, V. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Jun. 1997; 12p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

A team of young scholars, engineers and pilots possessing already a practical experience of researches in the area of aerohydrodynamics at the Computation and Research Bureau (CRB) established within the Moscow High Technical College (Moskovskoe Vysshee Tehnicheskoe Uchilishe MVTU) in 1916 formed the kernel of TsAGI headed by N.E. Zhukovsk . The foundation for these researches was laid by a methodology created by N.E Zhukovsky and consisting in a continuous combination of fundamental, searched-for and applied researches with experimental investigations in the wind tunnels. This principle was preserved and developed through all stages of activities of TsAGI where the problems of creation of the experimental aerodynamic equipment and development of the scientifically grounded test methodology had always been of primary emphasis.
Derived from text
Aerodynamic Characteristics; Computation; Hydrodynamics; Wind Tunnel Tests

19970029164 McDonnell-Douglas Corp., Long Beach, CA USA
Some Constraints Imposed on the Aerodynamic Development Process by Wind-Tunnel Circuit Design Characteristics
Lynch, F. T., McDonnell-Douglas Corp., USA; Crites, R. C., McDonnell-Douglas Corp., USA; Jun. 1997; 12p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Requirements for obtaining reliable and meaningful data in most wind tunnel test situations are addressed from an aircraft industry user's perspective. Factors considered are Reynolds number requirements, tunnel flow quality requirements, and tunnel wall and support system effects. Factors which are important in satisfying timeliness and cost effectiveness requirements are also identified. Important flow quality imperfections which exist with less-than-perfect wind-tunnel circuit aerodynamic design are considered, together with a review of the existing knowledge base for assessing the likely/potential effects of variations in these imperfections on the resultant test data. The need to have a thorough knowledge of the important flow physics features which are controlling the aerodynamic, aeroacoustic, and/or propulsion characteristics of the vehicle or flow situation under investigation at the associated test conditions is stressed in order to adequately understand and identify wind-tunnel flow quality requirements and effects on data quality, accuracy, and adequacy. The importance of not limiting the identification of potential data errors and measurement uncertainties to just those which can be currently quantified with existing analytical and computational methods is also stressed, as is the importance of understanding the aerodynamic design and validation process in which the data is being used, and the risk involved in the particular design being investigated. Additional considerations which need to be given attention when conducting some specialized types of tests (icing, semispan, open throat, etc.) are addressed. Examples of observed and easily-envisioned flow-quality variation effects on measured aerodynamic characteristics are presented. Lastly, prospects for improving tunnel flow quality through application of current advanced CFD capabilities are highlighted, as well as prospects for incorporating advanced test-section wall ventilation concepts to enable more reliable and cost effective high Reynolds number testing capabilities.
Derived from text
Aerodynamic Characteristics; Design Analysis; Fluid Dynamics; High Reynolds Number; Reynolds Number; Throats; Wind Tunnel Tests

19970029165 National Aerospace Lab., Marknesse, Netherlands
General Design Aspects of Low Speed Wind Tunnels
Jaarsma, F., National Aerospace Lab., Netherlands; Aerodynamics of Wind Tunnel Circuits and their Components; Jun. 1997; 16p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Since the sixties NLR was considering conceptional layouts and airline diagrams for the next generation low speed wind tunnels. This has resulted in the construction of a multi-purpose pilot facility in the early seventies. Based on the experiences gained from this facility, three major wind tunnels have been realized and are in full operation to great satisfaction of the operators and users: namely the DNW (1980) and LST (1983) facilities in the North East Polder in The Netherlands and the ILST (1987) near Jakarta in Indonesia. In this report the general design considerations in terms of aerodynamic and testing requirements are reviewed and are compared with the actual achievements. Also other operational aspects, such as logistics, acoustics, local constraints, and model supports are considered. From these aspects some lessons learned are concluded and recommendations made.
Derived from text
Low Speed Wind Tunnels; Construction; Airline Operations; Aerodynamic Characteristics; Acoustics

19970029166 Defence Research Agency, Farnborough, UK
The Aerodynamic and Structural Design of the DRA 5-Metre and ONERA F1 Low-Speed Pressurised Wind Tunnels
Woodward, D. S., Defence Research Agency, UK; Francois, G., Office National d'Etudes et de Recherches Aerospatiales, France; Taylor, N. J., Defence Research Agency, UK; Jun. 1997; 48p; In English; Also announced as 19970029162; Copyright Waived;

Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper describes the aerodynamic and structural design of two pressurised low-speed tunnels built in the 1970's to achieve a Reynolds number of 6 x 10(exp 6) and, at the same time, to enable the effects of compressibility and scale to be studied independently in tests of aircraft models in take-off and landing configurations. Despite being designed to similar specifications and providing comparable levels of flow quality, productivity and customer confidentiality, the tunnels differ significantly in several important aspects of their design. The principal features of the two designs are reviewed and a few examples of the compressibility and scale effects that have emerged from the test programmes in each tunnel are presented.

Author

Aircraft Models; Compressibility Effects; Reynolds Number; Structural Design; Wind Tunnels

19970029167 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia

Subsonic Wind Tunnel with Flow Speed Pulsation

Ryabokon, M. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Malyk, A. G., Tsentralni Aerogidrodinamicheskii Inst., Russia; Jun. 1997; 8p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

A number of calculations and experiments within the program of developing a subsonic wind tunnel with flow speed pulsation in the test section were carried out at TsAGI. The wind tunnel was designed to perform aerodynamic tests of models in regularly fluctuating flows within the Mach number range up to 0.9 with the fluctuation amplitude up to 40% of the mean flow velocity amd the frequency of pulsations up to 20 Hz. One of the possible concepts of developing a wind tunnel with flow speed pulsation was used. Speed pulsation is generated using rotating elliptic shafts located parallel in one of the wind tunnel cross sections downstream of the test section. The air is injected into the wind tunnel from the atmosphere by means of an ejector. The results obtained were applied for designing a wind tunnel prototype with the 0.4 (W)x 0.7(H) m test section. Special attention in developing the wind tunnel was given to the problem of obtaining the velocity pulse shape in the test section close to the sine curve. For this purpose special correcting devices were introduced in the wind tunnel structure. Investigation showed that shock waves can be generated in pulsing flow at transonic flow velocities. The upper velocities at which no shock waves are generated have been determined.

Author

Aerodynamic Characteristics; Shock Waves; Rotating Shafts; Prototypes; Mach Number; Flow Velocity

19970029168 Politecnico di Milano, Dipt. di Ingegneria Aerospaziale, Milan, Italy

Aerodynamic Design of a Civil-Aeronautical Low Speed Large Wind Tunnel

Gibertini, G., Politecnico di Milano, Italy; Gasparini, L., Politecnico di Milano, Italy; Zasso, A., Politecnico di Milano, Italy; Jun. 1997; 10p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The new Civil-Aeronautical Low Speed Large Wind Tunnel is presented, which will be constructed in the near future at the Politecnico di Milano. This unconventional facility will allow for both civil environmental and aeronautical researches, respectively in a very large (14 x 4 m) low-speed test section and in a conventional high-speed test section (4 x 4 m). Based on the results of preliminary tests on a 1:9 scale model the design of some critical components was reviewed. This includes the numerical optimisation of the contraction ahead of the aeronautical test section, the inverse design of a new thick section for the corner vanes and an improved configuration of the bends upstream the civil-environmental test section. Tests performed to check the effectiveness of the proposed modifications, although showing that some work is still needed to fulfill the specified requirements, confirmed the feasibilty of this very peculiar wind tunnel.

Derived from text

Aerodynamics; Low Speed Wind Tunnels; Test Chambers; Optimization; Low Speed; High Speed

19970029169 Italian Aerospace Research Center, Capua, Italy

Experimental and Computational Aerodynamics Applications for an Icing Wind Tunnel Design

DeGregorio, F., Italian Aerospace Research Center, Italy; Esposito, B., Italian Aerospace Research Center, Italy; Mingione, G., Italian Aerospace Research Center, Italy; Vicini, A., Italian Aerospace Research Center, Italy; Jun. 1997; 10p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The Italian Center for Aerospace Research is committed to the design and construction of a new icing wind tunnel (IWT). The main feature of an icing wind tunnel with respect to a traditional aerodynamic one is to have a heat exchanger to cool the air flux, and a spray-bar, normally located in the settling chamber, to generate water droplets simulating the supercooled water droplets clouds that can be encountered in flight conditions. The IWT will have peculiar characteristics, such as flight altitude pressure and humidity control, and large droplet simulation (larger than those indicated in present FAA regulations). The need for these

features has been identified in the preliminary design phase, and their impact on the design has thus been evaluated. In this paper a short description of the main characteristics of the CIRA IWT will be given, and some of the experimental and theoretical studies that have been carried out during the feasibility study will be illustrated.
Derived from text
Computational Fluid Dynamics; Altitude Control; Settling; Ice Formation; Flight Conditions; Drops (Liquids); Drop Size

19970029170 Boeing Co., Aerodynamics, Noise and Propulsion Lab., Seattle, WA USA
Development of Boeing Research Aerodynamic Icing Tunnel Circuit
Chintamani, Seetharam, Boeing Co., USA; Delcarpio, Danny, Boeing Co., USA; Langmeyer, Greg, Boeing Co., USA; Jun. 1997; 28p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

There is a general understanding that aircraft design is a mature technology. All leading airframe manufacturers produce a high quality product, with a blend of sophisticated computational fluid dynamics programs and extensive wind tunnel tests. Prediction of flight characteristics and performance is usually made with previous in-house methodology backed with years of experience. On closer examination, however, there are areas where significant improvement can be made. Improvement opportunities exist for current processes in all phases of product development and manufacture. Better processes result in substantial reduction in cost and time. One of the areas was a close examination of the certification process relating to aircraft icing. Until 1990 an airframe manufacturer was required to fly the airplane through the cloud characterized by the FAA regulation (FAR Part 25) to obtain realistic ice shapes on relevant airplane parts, such as wings, horizontal and vertical tails and ram air turbines, etc. Based on the shapes of accreted ice during flight, molds were prepared. Demonstration of handling qualities is carried out with the shapes derived from the natural icing tests, attached to appropriate locations of the airplane. Flight testing of an airplane to extract the ice shapes in order to estimate the performance degradation and demonstration of airworthiness is a very tedious and expensive process. The Boeing Company, with the support of the FAA, proposed to simplify the airworthiness certification process on aircraft icing. The first part of the process is the extraction of the shape of ice accretion on airplane components. The FAA has issued guidelines for the development of ice shapes in the wind tunnel instead of by flight testing. The FAA emphasized that in order to establish 'certifiable' quality data, the flow qualities of the new tunnel must be equal to or superior in comparison to the NASA Lewis Icing Research Tunnel. The Aerodynamics Laboratory and Mechanical Systems Laboratory of the Boeing Company decided to modify an existing low-speed research tunnel to include icing test capability in addition to conducting basic low-speed aerodynamic research. In order to achieve good flow quality, particularly through the modification of the existing facility, the wind tunnel designer is faced with interesting design challenges. This paper describes some unique designs of the tunnel components and the results of the calibration.
Author
Aerodynamics; Aircraft Design; Aircraft Icing; Aircraft Reliability; Computational Fluid Dynamics; Controllability; Flight Characteristics; Ice Formation; Stabilizers (Fluid Dynamics); Wind Tunnel Tests

19970029171 Central Inst. of Aviation Motors, Moscow, Russia
New Test Cell Design Methods Based on Integrated Usage of Calculated and Experimental Researches
Kabakov, I. I., Central Inst. of Aviation Motors, Russia; Timoshin, A. N., Central Inst. of Aviation Motors, Russia; Jun. 1997; 10p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The results of integrated usage of mathematical and physical models to develop aerodynamic lay-outs of altitude and sea-level test cell components to test aviation engines are presented in the report. Performances of dissipative layers in the intake manifold are investigated. New schemes of effective gas flow mixing are developed. The method for pressure control by inducing jets in the pressure cell is given. The basic principles for engine simulators creation are shown.
Author
Mathematical Models; Altitude Tests; Jet Control

19970029172 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
ETW Aerodynamic Design: A Case Study
Bouis, X., Office National d'Etudes et de Recherches Aerospatiales, France; Prieur, J., Office National d'Etudes et de Recherches Aerospatiales, France; Tizard, J. A., Tizard (J. A.), UK; Hefer, G., ETW G.m.b.H., Germany; Jun. 1997; 14p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The European Transonic Windtunnel ETW offers flight/near flight Reynolds numbers. This paper addresses the definition of the basic specification and the expansion of this basic specification into an overall aerodynamic design and concept of control of the facility. The rationale used in the definition of various tunnel components is explained and an overview of some of the studies and calculation methods employed to achieve the design of different sections of the tunnel are given. The need of test rigs is dis-

cussed and some details of the use of the pilot facility PETW in the development of the design are presented. The calibration methods and calibration results showing that the design was successfully implemented are outlined and show the excellent quality that is currently being achieved and demonstrate that the design concept works up to full flight Reynolds numbers.
Derived from text
Integrated Mission Control Center; Transonic Flight; Aerodynamics

19970029173 Office National d'Etudes et de Recherches Aerospatiales, CERT, Toulouse, France
Control and Mathematical Model of Transonic Wind Tunnels ***Modelisation et Pilotage des Souffleries Transsoniques***
Gobert, J. L., Office National d'Etudes et de Recherches Aerospatiales, France; Jun. 1997; 8p; In French; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Presently, a large part of wind tunnel testing concerns the subsonic and transonic ranges for civil transport aircraft; one particular topic in such type of tests is that the flow parameters (Mach number, pressure, temperature) require to be controlled with a high level of accuracy. Then, today's wind tunnels shall be equipped with an efficient control system capable to take the best of their performances. During the acquisition of data on the model, the flow parameters shall be maintained within small tolerances, leading to a restricted number of tests performed with a high level of quality in very well defined conditions. The operations of interpolation to be carried out during data postprocessing are minimized and the task of the aerodynamicists while scaling up the results to the actual flying conditions shall be easier. On another hand, dead times during the transition periods when going from one set point to another one shall be reduced to keep the running costs as low as possible. This document presents a control technic which was originally developed at ONERA and then adapted, improved and implemented in a recently built and large facility, the European Transonic Wind tunnel ETW erected in Cologne (Germany). During the first years of the ETW design, a computer dynamic model of the facility has been developed to support the control activities. This model, based on the knowledge of the aerodynamic phenomena present in the wind tunnel circuit, simulates the effects of heat transfers and temperature propagation along the circuit as well as the breathing of the Plenum Chamber. It performs a time simulation of the wind tunnel physical phenomena; at each time step, the parameter variations are integrated using the thermodynamics equations. In a following stage, control laws have been studied to drive the into the wind tunnel control system in order to drive the actual process. Results of tests recorded on the actual plant are included in the document. At the present time, a task is undertaken to enhance the performances of the ONERA S1 and S2 wind tunnels. The way this technic can be adapted to existing wind tunnels in order to trace the possible weaknesses of the facility, to correct them and improve the overall behavior are quickly discussed and supported by results of simulation. It is demonstrated that this type of dynamic model can be used to design or redesign, set up and tune a transonic wind tunnel control system in an efficient and economical way as well as to improve the overall performances. Use of this technique enabled to run the ETW facility almost from the first days in automatic mode minimizing considerably the time required to tune the control system and provide quickly satisfactory results.
Author
Aerodynamic Characteristics; Computerized Simulation; Dynamic Models; Flow Characteristics; Mach Number; Thermodynamics; Transonic Wind Tunnels

19970029174 Academy of Sciences (USSR), Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR
Elaboration of Cryogenic Transonic Short-Duration Wind Tunnel at ITAM
Zvegintsev, V. I., Academy of Sciences (USSR), USSR; Omelaev, A. I., Academy of Sciences (USSR), USSR; Jun. 1997; 10p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The research program directed to the transonic cryogenic wind tunnel creation have been carried out at the ITAM. Two variants of short-duration cryogenic wind tunnels have been worked out as paper projects. One of them is constructed as a classic blow-down wind tunnel. Here the cold air (or nitrogen) is collected within thermoinsulated storage vessels at a pressure up to 20 MPa and temperature 190 K. During a run the gas is flowing into the settling (plenum) chamber wherein its pressure falls down to 1 MPa and temperature to 120 K due to throttling effect. The cold gas flowing out is accompanied by high pressure and ambient temperature air flowing into the accumulator thus practically constant stagnation parameters of flow will be kept during the run. Another variant is constructed as a modified Ludwieg tube tunnel. The modification consists of an additional reservoir attached to the high-pressure tube with a perforated baffle (wall) between them. Such a device allows one to eliminate reflected rarefaction waves and to prolong useful running time. An experimental program has been initiated at short-duration impulse gasdynamic facility where the first mentioned variant of transonic wind tunnel was checked out. A transonic flow with good uniformity after

throttling device was brought off was achieved during these tests. The experiments carried out at TsAGI (Moscow) allow one to establish the conditions when the reflected wave is eliminated for the second version of the tunnel.
Author
Transonic Wind Tunnels; Accumulators; Cryogenic Wind Tunnels; Stagnation Flow; Throttling; Reflected Waves; Plenum Chambers

19970029175 Central Research Inst. of Machine Building, Kaliningrad, Russia
The Impulse Transonic Wind Tunnel U-11: New Effective Technology for Generation of Sub-, Trans- and Supersonic Gas Flow
Kislykh, V. V., Central Research Inst. of Machine Building, Russia; Koudriavtsev, V. V., Central Research Inst. of Machine Building, Russia; Petrova, O. V., Central Research Inst. of Machine Building, Russia; Puchkov, V. V., Central Research Inst. of Machine Building, Russia; Jun. 1997; 14p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

New technology for generation of sub-, trans-, and supersonic gas flows along with technology based on the impulse transonic wind tunnel ITT U-11 (nozzle dia 0.8) operated at TSNIIMASH are presented. The most important units and systems of the wind tunnel, test results on flow parameters in the working section and also their comparison with the same parameters for usual intermittent wind tunnels are described. The comparison has shown that suggested technology and the wind tunnel design, which allow to reduce essentially wind tunnel dimensions and power consumption, may be used for development of special rigs for complex investigation of aero-gas-dynamic and acoustic characteristics of flight vehicle models with engine jet simulation.
Author
Flow Characteristics; Gas Flow; Supersonic Flow; Transonic Wind Tunnels; Wind Tunnel Tests

19970029176 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany
A New Tool for Screen Integration in Internal Flow Systems and its Application to Wind Tunnel Design
Seltsam, M. M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Jun. 1997; 12p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

To consider mesh screens in internal fluid flow a numerical method is modified. A Navier-Stokes method with the standard k-e turbulence model is employed. The new extended numerical method is applied to wide-angle diffuser flow. The comparison of calculated diffuser flows with experimental results yields the requisite correspondence. The numerical and experimental investigations lead to a modification of the actual windtunnel. After realization of the modification a remarkable reduction of spatial velocity disturbances is achieved. The capability of screens to suppress turbulence is displayed by comparison of turbulence level distributions before and past the optimization of the settling chamber.
Author
Navier-Stokes Equation; Turbulence Models; Mesh; Fluid Flow

19970029177 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia
Adaptive-Wall Perforated Test Section for Transonic Wind Tunnels
Neyland, V. M., Tsentralni Aerogidrodinamicheskii Inst., Russia; Ivanov, A. I., Tsentralni Aerogidrodinamicheskii Inst., Russia; Semenov, A. V., Tsentralni Aerogidrodinamicheskii Inst., Russia; Semenova, O. K., Tsentralni Aerogidrodinamicheskii Inst., Russia; Amirjanz, G. A., Tsentralni Aerogidrodinamicheskii Inst., Russia; Jun. 1997; 16p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The review will be presented on the experimental study of using variable wall porosity for the methodical and productive wind tunnel testing of the aircraft models. Except for brief discussion of present state in this area the main reported results are based on the experience of exploitation of different porous wall test sections of TsAGI T-128 wind tunnel. This facility has 4 interchangeable test sections, each of them equipped with the specially designed variable porous walls according to the testing specialty. For example, test sections Nl and N2 have each 128 controlled sections designed as overlapping porous surfaces with the open area ratio variation from 0 to 18%. Test section N3 is equipped with longitudinally- variable slots, open area ratio changing from 0 to 13%. This test section is used for 2-D airfoil testing and has all the necessary instrumentation: controlled wall boundary layer suction upstream from the model, 2 degree of freedom wake survey mechanism, pressure measurement system for 1200 points on the basis of electronic modules etc. Test section N5 serves for aeroelastic model testing. Adjustable wall porosity is designed only in model location area. It is used not only for wall interference reduction but also as a flow excitation source. As an example of different adaptive-wall test sections, data are presented on two geometrically-similar A4 airfoils tested in the test section N3.

Reference model AEDC-2, tested in section Nl, is compared to the 1 6-T wind tunnel test of the same model. Also, results of the ”flying” strut test in section NS is presented.
Author
Aerodynamic Interference; Aeroelasticity; Aircraft Models; Airfoils; Boundary Layers; Degrees of Freedom; Transonic Wind Tunnels; Wind Tunnel Tests

19970029178 Institute for Aerospace Research, Aerodynamics Lab., Ottawa, Ontario Canada
Alleviation of Axial Static Pressure Gradients in 2D Perforated Test Section of IAR Blowdown Wind Tunnel
Tang, F. C., Institute for Aerospace Research, Canada; Chan, Y. Y., Institute for Aerospace Research, Canada; Jun. 1997; 8p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The complicated flow mechanism in the empty porous 1AR 2D test section including the plenum chamber and downstream diffuser section was studied and postulated. The forward-facing inclined holes in the test section top and bottom walls resulted in the plenum pressure being higher than the test section static pressure. The original test section side walls were too short and a big opening was formed between the test section and the downstream diffuser. The plenum air mass was readily entrained through this opening by the free jet flow formed downstream of the test section. The removal of the plenum air mass from this opening effectively lowered the plenum pressure resulting in the outflow phenomenon in the test section. With the presence of a long side wall extension the opening between the test section and the downstream diffuser section would be shortened. The plenum mass flow was greatly reduced as entrainment was decreased due to a shorter free jet flow. A pressure equilibrium condition between the plenum and the test section was thus established resulting in a constant pressure distribution along the test section. This paper presents the results obtained during the commissioning of this extended side wall configuration and the subsequent modifications made to it. A close to optimum configuration for the IAR 2D test section extension has been found.
Author
Blowdown Wind Tunnels; Air Masses; Free Jets; Jet Flow; Pressure Distribution; Pressure Gradients; Static Pressure

19970029179 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia
Evaluating Analytically and Experimentally the Gas Dynamics of Transonic Wind Tunnels with Devices for Air Evacuation from Plenum Chamber
Verkhovsky, V. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Lyzhin, O. V., Tsentralni Aerogidrodinamicheskii Inst., Russia; Pasova, Z. G., Tsentralni Aerogidrodinamicheskii Inst., Russia; Jun. 1997; 6p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The report provides results of experimental evaluation of flow in a transonic wind tunnel with forced suction from the plenum chamber surrounding a perforated test section. It is shown that the test section exit part features an air outflow into the plenum chamber, this decelerates flow, increases pressure, and decreases the Mach number at the entry into the main subsonic diffuser of the wind tunnel. In this case, total pressure losses become notably less. Also reported are results of experimental investigations into operation of a large wind tunnel with the suction system which extends the ranges of Mach and Reynolds numbers and reduces total pressure losses.
Author
Plenum Chambers; Transonic Wind Tunnels; Subsonic Wind Tunnels; Reynolds Number; Gas Dynamics

19970029180 ETW G.m.b.H., Cologne, Germany
Adaptive Slots: An Alternative Concept to Reduce Wall Interference
Quest, J., ETW G.m.b.H., Germany; Nitsche, W., Technische Univ., Germany; Mignosi, A., Centre d’Etudes et de Recherches, France; Jun. 1997; 10p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

An alternative concept to reduce wall interference in wind-tunnel testing by means of adaptive slots is presented and its benefits are highlighted by means of experimental as well as numerical investigations. The qualification of the 3d-NAVIER-STOKES code employed for the parametric numerical investigations is demonstrated by comparison with Laser 2-focus and surface pressure measurements. The effectiveness of a single central adaptive slot is proved for a convex profile as well as for a body of revolution by referencing the results to 2d wall adaptions. For a simplified 3d slot, adaptation featuring 6 slots on each top and bottom wall have better agreement with the freestream solution than for the 2d wall adaptation that was achieved.
Author
Aerodynamic Interference; Free Flow; Lasers; Pressure Measurement; Wind Tunnel Tests

19970029181 City Univ., London, UK

Progress in Determining Wall-Induced Interference in Slotted-Liner Wind Tunnels Using Measured Wall Conditions

Freestone, M. M., City Univ., UK; Sykes, D. M., City Univ., UK; Jun. 1997; 12p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Further work and analysis relating to a previously proposed scheme for determining slotted-liner wall-induced interference at subsonic speeds are presented. The scheme utilises measurements of wall (slat) pressures and values of the velocity-component normal to the liner measured in the plane of the liner along a slot centre line. This flow component is measured by a probe, and longitudinal distributions of the normal velocity are obtained both from traverses and multiple point measurements. With a three-dimensional test configuration, measurements would be made on each slat and slot, but in the present tests with a two-dimensional aerofoil the slats and slots in each wall (roof and floor) are assumed to behave equally. Assessment of the results of utilising the scheme is based on comparisons of aerofoil pressures at corrected conditions of Mach number and (three-quarter chord) incidence. More detailed assessment by other means is suggested. The scheme appears reliable for the range of test conditions undertaken, and these more than adequately cover conditions likely to be found in the large three-dimensional test facilities for which the method is intended.

Author

Aerodynamic Interference; Airfoils; Mach Number; Slotted Wind Tunnels; Subsonic Speed; Wall Flow; Wall Pressure

19970029182 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia

Aerodynamic Design of Axial-Flow Fans for Subsonic Wind Tunnels

Brusilovsky, I. V., Tsentralni Aerogidrodinamicheskii Inst., Russia; Jun. 1997; 8p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The report highlights features of wind tunnel fans with axial annular diffusers, as well as relations for defining fan parameters (including the total pressure loss factor) with the aid of the equivalent diffuser length and the total pressure loss coefficient of a planar diffuser. Test data on planar and annular diffusers (including data on the annular diffusers tested with fans) are compared. Foundations of fan aerodynamic design are provided; this is subdivided into two principal stages: (1) determining the basic parameters (volume-averaged axial flow-speed coefficient, theoretical pressure coefficient, and two new parameters: the prewhirl upstream of an impeller and the residual whirl downstream of an outlet guide vane) as well as the fan hub diameter; (2) shaping the guide vanes and impeller blading. The operational envelope is outlined; taking parameters in this domain ensures creating a fan with really separation free flow about blades both at a rated regime at a maximum possible efficiency and over a certain domain around the rated regime. The design parameters are selected, and efficiency evaluated, in the general form for a complete fan configuration comprising an inlet guide vane (IGV), the impeller, and an outlet guide vane (OGV). Results for configurations without one or two guide vanes are the corresponding particular cases. Expressions for optimizing the design parameters and the respective efficiency are derived. Theoretical and experimental values of the two new parameters of flow whirl are compared. The shaping procedure (i.e., defining the airfoil setting angle, shape, curvature, the blade array spacing, rated airfoil angle of attack, total number and shapes of the blades) is based on generalized test data; the relations allow for radial blading-variation and the ”distance” to the maximum pressure on the fan characteristic curve. Airfoil setting angles and radial variation of airfoil curvature are proposed to be deEmed from theoretical data on airfoil arrays on the basis of a unified method for all bladed components with arbitrary array density. This aerodynamic design method developed at GOSNITs TsAGI has been used and improved for more than 45 years and has been comprehensively verified.

Author

Subsonic Wind Tunnels; Turbofans; Pressure Ratio; Impellers; Guide Vanes; Free Flow; Flow Coefficients; Curvature; Axial Flow; Angle of Attack

19970029183 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia

Ejector-Driven Wind Tunnels

Arkadov, Y. K., Tsentralni Aerogidrodinamicheskii Inst., Russia; Roukavets, V. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Jun. 1997; 10p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The experience accumulated at the Central Aerohydrodynamic Institute for many years in calculating, designing, and running wind tunnels in which pressure difference is produced by a jet ejector-compressor, is analyzed. Theories for optimal gas ejectors and their systems are given, new schemes of gas ejectors of improved performance are discussed, and problems of improving

economic efficiency of the 'wind tunnel-gas ejector' system are considered. Examples of successful use of ejectors as major drivers of subsonic, trans-, and hypersonic wind tunnels are presented.
Author
Wind Tunnels; Compressors; Ejectors; Wind Tunnel Apparatus; Systems Engineering; Design Analysis; Gas Jets

19970029184 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia
Improving Transonic Wind Tunnel Compressor Operation by Means of Guide Vane Angle Optimization
Kukinov, A. G., Tsentralni Aerogidrodinamicheskii Inst., Russia; Dyadchenko, G. E., Tsentralni Aerogidrodinamicheskii Inst., Russia; Lunyov, A. A., Tsentralni Aerogidrodinamicheskii Inst., Russia; Panasenko, V. S., Tsentralni Aerogidrodinamicheskii Inst., Russia; Jun. 1997; 6p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The implementation of adjustable guiding vanes (AGV) for optimizing the angle of setting for improvement of the transonic wind tunnel's compressor characteristics is considered. Experimental research results of the gas dynamic characteristics of the T-128 wind tunnel's compressor and dynamic stress in its blades are presented. The necessity of monitoring the operation point position in the compressor operating envelope for providing its stable operation is shown.
Author
Transonic Wind Tunnels; Guide Vanes; Wind Tunnel Apparatus; Compressors; Systems Engineering; Gas Jets; Angles (Geometry); Design Analysis

19970029185 Machine-Building Design Bureau, Moscow, Russia
Development of Close-Circuit Subsonic Wind Tunnel with Diametral Fan
Korovkin, A. G., Tsentralni Aerogidrodinamicheskii Inst., USSR; Savchuk, V. D., Machine-Building Design Bureau, Russia; Kuroles, V. K., Machine-Building Design Bureau, Russia; Jun. 1997; 8p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In this paper the features of air flow in a diametral fan (DF) contour and its aerodynamic characteristics are reported. The field of application for the DF in the wind tunnels is determined. The results of experimental investigations of DF geometrical parameters effect on DF aerodynamic parameters are given. The performance data of the MBDB Raduga compact subsonic wind tunnel and the Laboratory Training Aerodynamic Complex (ULAK) for Technical Schools which is developed on its base are offered. The method of approximate simulation of following a body contour with a liquid with free surface in a wide range of F(z) numbers for subsonic wind tunnels is proposed, and the possibility of DF use in the installations of this type is considered.
Author
Subsonic Wind Tunnels; Aerodynamic Characteristics; Wind Tunnel Apparatus; Systems Engineering; Design Analysis; Compressor Rotors; Air Flow; Circuits

19970029186 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia
Experimental Study of a Low-Speed Wind Tunnel Test Section with a Free Jet
Roukavets, V. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Byrkin, A. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Iskra, A. L., Tsentralni Aerogidrodinamicheskii Inst., Russia; Filatov, A. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Troitsky, V. V., Tsentralni Aerogidrodinamicheskii Inst., Russia; Ponomaryova, V. C., Tsentralni Aerogidrodinamicheskii Inst., Russia; Holzdeppe, D., Turbo-Lufttechnik G.m.b.H., Germany; Papenfuss, H. D., Ruhr Univ., Germany; Barbagallo, D., Italian Aerospace Research Center, Italy; Jun. 1997; 14p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Results of experimental study of various configurations of the subsonic wind tunnel test section with a free jet and Eiffel chamber are presented in order to determine its optimum variant corresponding to minimum values of velocity and pressure pulsation, hydraulic losses and flow non-uniformity in the model location zone. At a given reduced jet length the parameters of the test section configuration were provided by varying the relation of the diffuser entry section area to the nozzle exit section area and by variations of the collector placed in front of the diffuser. Different forms of the collector were studied: one-piece contracting collector, contracting collector adjusted along the angle and collector with parallel walls. From the collectors investigated the best in the aggregate of the flow efficiency criteria is the one-piece contracting collector with an angle of inclination of walls alpha(c) is approx. equal to 14 degrees and an optimum relative value of the gap between it and the diffuser is approx. equal to 0.2.
Author
Subsonic Wind Tunnels; Test Chambers; Free Jets; Wind Tunnel Apparatus; Wind Tunnel Tests; Systems Engineering; Design Analysis; Wind Tunnel Models

19970029187 Duits-Nederlandse Windtunnel, North East Polder, Netherlands

Model and Full Scale Investigations of the Low Frequency Vibration Phenomena of the DNW Open Jet

Holthusen, H., Duits-Nederlandse Windtunnel, Netherlands; Kooi, J. W., Duits-Nederlandse Windtunnel, Netherlands; Jun. 1997; 8p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The German-Dutch Wind Tunnel DNW is a large low speed wind tunnel with three different sized closed and one open test sections (Open Jet). Already during the first calibration phase of the Open Jet in 1981, it soon became clear that the maximum jet velocity was not limited by the available fan power, but by the maximum allowable vibrations of the Test Hall which surrounds the Open Jet. Due to low-frequency pressure fluctuations generated by the Open Jet, the vibrations reached levels which could become critical for the Test Hall structure. In order to be able to increase the maximum velocity beyond this 80 m/s an extensive research programme was executed in the 1:10 scaled pilot wind tunnel of DNW. The objective of this programme was to find the sources of the observed low frequency pressure fluctuations and to verify different configurations for their potential to reduce the vibration level. The tested configurations included a number of well-known nozzle modifications as well as a new configuration with so-called tetrahedrons. The effect of modifications of the collector geometry and the effect of extra bleeding was also investigated. After completing the tests in the pilot wind tunnel, the most promising solutions were tested in the DNW. It turned out that the results found in the two wind tunnels correlated very well. A surprising outcome was that in both tunnels the tetrahedrons increased the jet speed without a noticeable reduction of the usable cross section of the Open Jet and without increasing the acoustic background noise level.

Author

Low Speed Wind Tunnels; Pressure Oscillations; Test Chambers; Wind Tunnel Apparatus; Systems Engineering; Design Analysis; Structural Vibration; Jet Flow; Acoustic Frequencies; Background Noise; Tetrahedrons

19970029188 Tsentralni Aerogidrodinamicheskii Inst., Moscow, USSR

Self-Oscillation Flow Control in Free-Jet Wind Tunnels

Ginevsky, A. S., Tsentralni Aerogidrodinamicheskii Inst., USSR; Jun. 1997; 12p; In English; Also announced as 19970029162 Contract(s)/Grant(s): RFFI-96-02-19577; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

In wind tunnels with the open test section strong, self-oscillations arise at certain flow velocities which are accompanied by a sharp increase of pressure and velocity pulsations in the test section. Traditional methods of self-oscillation control do not provide complete suppression. In the work presented the acoustic methods of self-oscillation control (their suppression or generation), based on the coherent jet structure response to periodic excitation have been investigated. The experiments were carried out in four wind tunnels with different outer diameters of the exhaust nozzle d = 0.15-2.2 m.

Author

Wind Tunnels; Self Oscillation; Test Chambers; Unsteady Flow; Free Jets; Wind Tunnel Nozzles; Flow Stability; Design Analysis; Systems Engineering; Air Ducts

19970029189 Case Western Reserve Univ., Mechanical and Aerospace Engineering, Cleveland, OH USA

Turbulence and Noise Criteria and their Implementation in NWTC-Type Wind Tunnels

Reshotko, Eli, Case Western Reserve Univ., USA; Saric, William S., Arizona State Univ., USA; Nagib, Hassan M., Illinois Inst. of Tech., USA; Jun. 1997; 14p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper considers the establishment of turbulence and noise criteria as a function of Mach number and total pressure for utilitarian low-speed and transonic wind tunnels of the National Wind Tunnel Complex (NWTC) class facilities such that boundary-layer transition models likely to be tested in them will not be contaminated by the flow environment. Aside from the NWTC tunnels themselves, the ideas in this paper apply to upgrades and revisions of existing tunnels such as the NASA-Ames 11-foot Unitary Tunnel and the AEDC 16T tunnel.

Author

Transonic Wind Tunnels; Low Speed Wind Tunnels; Turbulence; Boundary Layer Transition; Noise (Sound); Boundary Layer Flow; Design Analysis; Wind Tunnel Apparatus

19970029190 Office National d'Etudes et de Recherches Aerospatiales, Meundon, France

Design and Validation of a Quiet Supersonic Wind Tunnel ***Conception et Qualification de la Soufflerie Silencieuse: R1Ch de l'ONERA***

Papirnyk, O., Office National d'Etudes et de Recherches Aerospatiales, France; Rancarani, G., Office National d'Etudes et de Recherches Aerospatiales, France; Delery, J., Office National d'Etudes et de Recherches Aerospatiales, France; Arnal, D., Centre

d'Etudes et de Recherches, France; Jun. 1997; 16p; In French; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The R1Ch blow down wind tunnel was recently converted into a quiet supersonic wind tunnel at Mach 3. In order for the boundary layers on the nozzle wall to remain laminar, the following tasks were accomplished: noise minimization coming from the upstream circuit, realization of suction upstream of the throat to eliminate the boundary layer in the contraction, optimization of the nozzle shape calculated in order to reduce Gortler vortex, and realization of a surface quality to avoid triggering of transition due to the roughness. The theoretical, numerical and technological works resulting in the realization of the wind tunnel, are presented with the description of the facility. A preliminary validation of the wind tunnel was done with: measurement of pressure fluctuations in the stilling chamber, probing of boundary layer upstream of the nozzle throat, probing of pitot pressure and flux measurement on plane plate in the test section, and probing of boundary layer in the nozzle exit plane.
Author

Supersonic Wind Tunnels; Test Chambers; Wind Tunnel Nozzles; Pressure Oscillations; Design Analysis; Vortices; Nozzle Design

19970029191 NASA Ames Research Center, Moffett Field, CA USA

Characteristics of the NASA-Ames Laminar Flow Supersonic Wind Tunnel for Unique Mach 1.6 Transition Studies

Wolf, Stephen W. D., MCAT Inst., USA; Laub, James A., NASA Ames Research Center, USA; Jun. 1997; 18p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Flow quality measurements have been performed in the unique Laminar Flow Supersonic Wind Tunnel (LFSWT) to examine both mean and dynamic characteristics. The intent was to provide the necessary flow information about this ground test facility, to support meaningful transition research at Mach 1.6 and flight unit Reynolds numbers. This paper is intended to assist other experimentalists with similar goals of characterizing low-supersonic test environments. An array of instrumentation has been used to highlight the importance of proper selection of pressure instruments and data acquisition procedures. We conclude that the test section is low-disturbance (based on classical standards of pressure disturbances less than 0.1% with no specified data bandwidth), and has uniform flow. This is confirmation that the quiet design features of the LFSWT are effective. However, characterization of the test section flow over a 0.25k-5Ok bandwidth shows that the disturbance levels can be greater than classical standards particularly for stagnation pressures less than 9.5 psia (0.65 bar) with low stagnation temperatures. Variability of the flow disturbances in the settling chamber and test section is contained in a narrow frequency bandwidth below 5k Hz, which is associated with resonant frequencies from the pressure reduction system. So far, these disturbances have not impacted transition along the tunnel walls or a 10 degrees cone. However, continual vigilance is required to maintain a known low-disturbance environment for transition research in the LFSWT. Furthermore, the formation of standards for flow quality measurements is strongly recommended, so that transition research can be better isolated from tunnel disturbances.
Author

Supersonic Wind Tunnels; Test Chambers; Uniform Flow; Laminar Flow; Supersonic Speed; Free Jets; Transition Flow; Wind Tunnel Apparatus; Noise (Sound)

19970029192 Academy of Sciences (USSR), Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR

Fluctuation Characteristics of Flows in Test Sections of High-Speed Wind Tunnels

Lebiga, V. A., Academy of Sciences (USSR), USSR; Zinoviev, V. N., Academy of Sciences (USSR), USSR; Jun. 1997; 10p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The results of fluctuation structure study in test sections of wind tunnels in the wide range of velocity (from large subsonic up to supersonic) are presented in this paper. A correlation between characteristics of the boundary layer on the test section walls of the supersonic wind tunnel with fluctuations in the flow core is shown. Detailed characteristics of fluctuations in ventilated test sections are given for different types of walls (perforated, slotted, smooth rigid). The constant current hot-wire anemometer and developed at ITAM technique have been used for fluctuation measurements and interpretation of the results.
Author

Flow Characteristics; Test Chambers; Wind Tunnels; Flow Stability; Turbulence; Reynolds Number; Wind Tunnel Apparatus; Boundary Layers; Wind Tunnel Walls; High Speed

19970029193 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia

Aerodynamic Design of Nozzles for Subsonic and Transonic Wind Tunnels

Byrkin, A. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Ponomaryov, S. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Ponomaryova, V. S., Tsentralni Aerogidrodinamicheskii Inst., Russia; Filatov, A. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Jun. 1997; 10p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This report gives results of theoretical considerations and experimental research on gas flows in axisymmetric nozzles of sub- and tran-sonic wind tunnels. Two classes of nozzle transverse contours were investigated at test section flow velocities corresponding to Mach numbers of M(infinity) = 0.1-1.0. Cross-section shapes for the first class of contours were calculated using the Witoszinski equation, and for the second class they were determined by the equations considered in the present report. It is shown that the flow pattern which takes place in the considered nozzles especially at nozzle entries, is not one dimensional. It is found, that the Witoszinski contour is unacceptable for a practical implementation of representative contraction factor and nozzle length-to-diameter ratio values; the reason is unacceptable negative longitudinal velocity gradient value on the wall near the nozzle entry, which can lead to boundary layer separation. Similar results are given for a gas flow in the nozzles having rectangular, circular, and octagonal transverse contours and also in the nozzle having circular transverse entry contour and octagonal transverse exit contour.
Author
Aerodynamic Characteristics; Subsonic Wind Tunnels; Transonic Wind Tunnels; Test Chambers; Nozzle Design; Nozzle Flow; Wind Tunnel Nozzles; Contours; Design Analysis; Gas Flow; Wind Tunnel Walls; Boundary Layer Separation; Nozzle Geometry

19970029194 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia
Method for the Calculation of 2D Supersonic Variable Nozzle Contours
Verkhovsky, V. P., Tsentralni Aerogidrodinamicheskii Inst., Russia; Jun. 1997; 6p; In English; Also announced as 19970029162; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The report considers a supersonic adjustable nozzle including a rigid acceleration-section and a flexible smoothing-section. These are proposed to be designed by the method that ensures a Mach number field (within 1% error) in the characteristic rhomb for a certain Mach number range, while requiring only a few adjustment points (where hydraulic actuators are attached). The method is based on numerical analysis of flow in a nozzle whose flexible section is described by a cubic spline. Consideration is given to nozzles with a maximum angle of the acceleration section of 10 through 18 degrees, which are intended to provide the exit Mach number of 1.2 to 4.0. It is shown that using three or four adjustment points in nozzles with inclination angle of less than 12 degrees ensures the characteristic-rhomb flow nonuniformity of no greater than 0.5%, and for angle less than 17 degrees the flow nonuniformity does not exceed 1%. In order to allow for air viscosity in nozzles designed to M less than 5.0, a general relation between the boundary layer displacement thickness and the Mach number is proposed.
Author
Supersonic Wind Tunnels; Nozzle Design; Nozzle Flow; Wind Tunnel Nozzles; Contours; Spline Functions; Design Analysis; Wind Tunnel Apparatus; Nozzle Geometry

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.

19970029547
Development of P/M gamma titanium aluminides for aero engine applications
Zhao, L., Natl Research Council Canada, Canada; Beddoes, J.; Au, P.; Wallace, W.; Canadian Aeronautics and Space Journal; December 1996; ISSN 0008-2821; vol. 42, no. 4, pp. 179-184; In English; Copyright; Avail: Issuing Activity

This paper summarizes the work on powder metallurgy gamma titanium aluminides performed at NRC over the last five years. Specifically, the microstructural evolution during processing, the hot workability, the creep behavior and microstructure-mechanical property relationships are discussed with emphasis on aero engine applications. The studies have shown that the microstructure of the powder materials can be controlled by hot isostatic pressing or heat treatment. A modified microstructure was successfully produced using an NRC novel heat treatment to improve balanced mechanical properties. The materials have good forgeability in a suitable temperature/strain rate regime. The microstructural parameters controlling creep, tensile and fracture toughness properties have been identified, which provides a useful guide to the microstructural design for gas turbine applications.
Author (EI)
Aerospace Engineering; Aircraft Engines; Creep Properties; Metallography; Microstructure; Powder Metallurgy; Titanium Alloys

19970030200 National Academy of Sciences - National Research Council, Panel on Materials, Washington, DC USA
Report of the Panel on Materials
Diefendorf, Russell J., Rensselaer Polytechnic Inst., USA; Grisaffe, Salvatore J., National Academy of Sciences - National Research Council, USA; Aeronautics Technology Possibilities for 2000: Report of a Workshop; 1984, pp. 99-128; In English; Also announced as 19970030196; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Materials and manufacturing technology are critical to advanced aircraft and permeate all disciplines. Current aircraft systems employ a variety of materials, each selected to provide the best vehicle design in terms of performance, safety, reliability, manufacturability, and life cycle cost. However, a mistake in materials selection could bankrupt an airframe or engine manufacturer. Thus, the introduction of new materials is a slow process. Generally, new materials are used initially in noncritical components until their performance in service can be confirmed. Then, as confidence grows, they are used in more and more critical applications. Finally, if appropriate, new materials are used in critical, static elements and then in dynamic components. Thus, because the nominal time for development of a conventional monolithic material ranges from 5 to 10 years there is a 10- to 15-year lag between laboratory effort and introduction into service. Therefore, to assure the availability of materials suitable for production aircraft and engines in the year 2000, the concepts already must have been identified and must be progressing along evolutionary paths toward application. Trends, actual and projected, in the use of materials for commercial engines are shown in Figure 4-1. Related military applications are projected to follow similar paths. The new actor will be composites. The panel examined a wide range of materials important to all aspects of aircraft development, airframe structures, propulsion systems and for other important aircraft subsystems. These are addressed in the body of the report in terms of the current state of the art, opportunities for improvement, and barriers to achievement of projected benefits. This is followed by projections of the progress of technology that could be realized by the year 2000 with the application of appropriate resources.
Derived from text
Aircraft Equipment; Aircraft Design; Aircraft Structures; Manufacturing; Propulsion System Configurations; Propulsion System Performance; Airframes

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.

19970028747 Army Research Lab., Cleveland, OH USA
Passage-Averaged Description of Wave Rotor Flow
Welch, Gerald E., Army Research Lab., USA; Larosiliere, Louis M., Army Research Lab., USA; Jul. 1997; 11p; In English; 33rd; Joint Propulsion Conference and Exhibit, 6-9 Jul. 1997, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 505-26-33
Report No.(s): NASA-TM-107518; E-10822; NAS 1.15:107518; AIAA Paper 97-3144; ARL-TR-1462; AD-A327034; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

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

19970028840 Virginia Polytechnic Inst. and State Univ., Dept. of Mechanical Engineering, Blacksburg, VA USA

Unsteady Aerodynamic and Heat Transfer Studies in a Highly-Loaded Transonic Turbine Rotor Cascade with Simulated Shock/Wake Passing ***Final Report, 1 Dec. 1992 - 30 Nov. 1995***

Ng, Wing F., Virginia Polytechnic Inst. and State Univ., USA; Diller, Tom, Virginia Polytechnic Inst. and State Univ., USA; Sep. 18, 1996; 6p; In English

Contract(s)/Grant(s): F49620-93-I-0047

Report No.(s): AD-A326163; AFOSR-TR-97-0270; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The objective of the research effort is to integrate fluid and heat transfer studies in a heated transonic turbine cascade in order to develop a better understanding of the complex flow physics involved in the coupling of the fluid flow and heat transfer phenomena in an unsteady flowfield. to that end detailed, time resolved aerodynamic and heat transfer measurements are taken in the experiments. Unsteady passing shock is generated in a shock tube and introduced into the test section of the cascade to simulate the shock wave passage similar to an actual turbine environment.

DTIC

Unsteady Aerodynamics; Aerodynamic Heat Transfer; Shock Waves; Unsteady Flow; Thermal Boundary Layer; Fluid Flow; Transonic Flow; Shock Tubes; Supersonic Turbines

19970029300 Physics and Electronics Lab. TNO, The Hague, Netherlands

A Comparison on Radar Range Profiles Between In-Flight Measurements and RCS-Predictions

vanderHeiden, R., Physics and Electronics Lab. TNO, Netherlands; vanEwijk, L. J., Physics and Electronics Lab. TNO, Netherlands; Groen, F. C., Physics and Electronics Lab. TNO, Netherlands; May 1997; 30p; In English

Report No.(s): AD-A327542; FEL-97-A069; TDCK-TD97-0103; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The validation of Radar Cross Section (RCS) prediction techniques against real measurements is crucial to acquire confidence in predictions when measurements are not available. In this report we present the results of a comparison on one dimensional signatures, i.e. radar range profiles. The profiles were measured from a target of opportunity, a Boeing 737. At the same aspect angles and frequencies, profiles were predicted using a high frequency RCS-prediction code in conjunction with a digitized model of the Boeing. Despite the assumptions and simplifications in both the prediction code and the aircraft model, a reasonable agreement is seen on head on and tail on aspect angles. The correspondence on broad side aspect angles is seen to be better: despite differences in peak amplitudes, normalised correlation coefficients up to 0.9 are observed.

DTIC

Radar Cross Sections; Prediction Analysis Techniques; Radar Range; Rangefinding; Aircraft Models; High Frequencies

19970029357 Second Air Supply and Maintenance Center Command, Kayseri, Turkey

Experimental Analysis of Effects of Anomalies in Structure of Radomes on Radome's Performance

Celikel, Sadik, Second Air Supply and Maintenance Center Command, Turkey; Gorur, Adnan, Nigde Univ., Turkey; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

In this study, radome structures, located in the nose section of aircrafts, which protect radar antennas from adverse environmental effects, fit to aircraft structures aerodynamically but which differ from other parts of aircrafts in terms of electrical features have been examined basically. Effects of radome structural anomalies to radome electrical performance have been investigated by bonding mica plates at some parts of electromagnetic window section of an F-4 nose radome which differ the thickness of the structure. Transmission loss, boresight error, boresight error measurements, have been achieved via B-350A Test Utility System. Consequently, experimental analysis of anomalies which occur as variation at density and thickness of radome structures have been evaluated.

Author

F-4 Aircraft; Radomes; Radar Antennas; Electrical Properties; Aircraft Structures

19970029530

Using integral coil to drive a two-axis gyroscope

Rao, S. Koteswara, N.S.T.L., India; IEEE Transactions on Aerospace and Electronic Systems; January 1997; ISSN 0018-9251; vol. 33, no. 1, pp. 322-328; In English; Copyright; Avail: Issuing Activity

Employing a coil assembly to drive a magnetic rotor makes a two-axis gyroscope simple and compact. A conventional coordinate-transformation method is introduced to derive the dynamic equations related to the gyroscope and to analyze the sensor coils that can provide the information about the gyro position with respect to the vehicle axis. by small angle approximation, a new

simplified linear model for analyzing the two-axis gimbaled platform of the navigation system is proposed. Within lambda less than or = 20 deg, it is successful to explain the performance of the platform.
Author (EI)
Coordinate Transformations; Electric Coils; Gyroscopes; Rotors; Transformations (Mathematics)

19970029537
Unsteady flow and shock motion in a transonic compressor rotor
Copenhaver, W. W., U.S. Air Force Wright Lab, USA; Puterbaugh, S. L.; Hah, C.; Journal of Propulsion and Power; January 1997; ISSN 0748-4658; vol. 13, no. 1, pp. 17-23; In English; Copyright; Avail: Issuing Activity

The results of an experimental and numerical comparison of the unsteadiness and shock motion that occurs in the tip region within a modern, low-aspect-ratio, high-through-flow, axial-flow transonic fan rotor are presented. The unsteadiness studied here is associated with local phenomena within the blade passage and not related to blade row interaction. Unsteady static pressures were measured at the casing over the rotor that operates at a tip relative Mach number of 1.6. An unsteady three-dimensional Navier-Stokes computational study was performed with tip clearance comparable to the test rotor. The fully three-dimensional, unsteady, Reynolds-averaged Navier-Stokes equations were solved with time steps, each nominally of 2.8 x 10(sup - 5) s in duration or approximately five times blade pass frequency. The results in the clearance gap were retained from the computational solution and compared with the experimental measurements. Both indicated deterministic unsteadiness near the location of the shock. High levels of unsteadiness were also measured downstream of the shock in the path of the clearance vortex, but this phenomenon was not predicted by the computation. The unsteadiness near the shock was shown to be a result of movement of the shock. The amplitude and frequency of shock position oscillation was estimated from the results to be about 2% chord and 2 kHz, respectively. Analysis of loss caused by the shock unsteadiness suggested that losses because of shock motion were insignificant relative to the steady shock loss at the relative Mach number studied.
Author (EI)
Axial Flow; Compressor Rotors; Compressors; Mach Number; Rotors; Shock Waves; Transonic Compressors; Transonic Flow; Turbomachinery; Unsteady Flow

19970029538
Tip clearance flow-shock interaction in a transonic compressor rotor
Puterbaugh, S. I., U.S. Air Force Wright Lab, USA; Brende, M.; Journal of Propulsion and Power; January 1997; ISSN 0748-4658; vol. 13, no. 1, pp. 24-30; In English; Copyright; Avail: Issuing Activity

A combination of experimental, computational, and analytical efforts were used to describe the phenomenological features of the interaction between the tip clearance flow and the passage shock in a transonic, axial compressor rotor. Unsteady static pressure was measured at the casing over the rotor, and steady measurements of total pressure and total temperature were made at the rotor exit. A fully three-dimensional, steady, Navier-Stokes computational fluid dynamics technique was used to obtain a solution to the flowfield at design conditions that compared favorably with the experimental measurements. Finally, a simple model was developed that predicts the kinematic and thermodynamic properties within the pre- and postshock vortex. Analysis of the numerical results revealed a wake-like nature of the vortex both upstream and downstream of the shock. The upstream character was strongly influenced by the injection of mass into the vortex via the clearance flow. The success of the simplified model's ability to predict the properties of the vortex within the interaction region allows two important conclusions to be drawn. First, the vortical character of the vortex upstream of the shock is not a significant factor in driving the interaction. Second, the interaction between the clearance flow and the shock is fundamentally the result of the change in momentum brought about by the shock-induced pressure rise. The interaction can therefore be viewed as an inviscid phenomenon.
Author (EI)
Axial Flow; Compressor Rotors; Compressors; Computational Fluid Dynamics; Flow Characteristics; Rotors; Transonic Compressors; Transonic Flow; Turbomachinery

19970029539
Computational study of rotating-stall inception in axial compressors
He, L., Univ of Durham, UK; Journal of Propulsion and Power; January 1997; ISSN 0748-4658; vol. 13, no. 1, pp. 31-38; In English; Copyright; Avail: Issuing Activity

Rotating-stall inception in axial-flow compressors has been studied computationally using a quasi-three-dimensional time-marching Navier-Stokes method with a mixing-length turbulence model. of particular interest was the effect of external circumferential disturbances corresponding to inlet stagnation pressure distortions and rotor/stator blade interactions. The present results show that rotating stall onset patterns in terms of number of stall cells and rotating speeds were influenced by small external cir-

cumferential stationary or rotational disturbances. First mode circumferential disturbances had the most destabilizing effect, resulting in a single-cell pattern rotating in the absolute frame at about 50% rotor speed, as is observed in most experiments. Short-scale multiple-cell patterns rotating at a higher absolute speed could also be excited by a disturbance with the same circumferential length scale. Short-scale multiple-cell patterns tended to be more persistent in an isolated blade row than in a stage. In the latter case, a short-scale pattern initiated by a rotor-stator interaction would quickly change into a long-scale single-cell pattern, associated with a distinct change of the rotating speed.
Author (EI)
Axial Flow; Compressors; Computational Fluid Dynamics; Inlet Pressure; Mathematical Models; Navier-Stokes Equation; Rotating Stalls; Rotors; Stagnation Pressure; Turbomachinery; Turbulence

19970028900 Phillips Lab., Propulsion Directorate, Edwards AFB, CA USA
Computer Aided Feature Extraction, Classification and Acceptance Processing of Digital NDE Data
Hildreth, Joseph H., Phillips Lab., USA; Dec. 1996; 13p; In English
Contract(s)/Grant(s): AF Proj. 4SL1
Report No.(s): AD-A325980; PL-TP-97-3003; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As part of the Advanced Launch System technology development effort begun in 1989, the Air Force initialized a program to automate, to the extent possible, the processing of NDE of NDE data from the inspection of solid rocket motors during fabrication. The computerized system, called the Automated NDE Data Evaluation System or ANDES, was developed under contract to Martin Marietta, now Lockheed Martin. The ANDES system is generic in structure and is highly tailorable. The system can be configured to process digital or digitized data from any source, to process data from a single or from multiple acquisition systems, and to function as a single stand-alone system or in a multiple workstation distributed network. The system can maintain multiple configurations from which the user can select. In large measure, a configuration is defined through the system's user interface and is stored in the system's data base to be recalled by the user at any time. Three operational systems are currently in use. These systems are located at Hill AFB in Ogden, UT, Kelly AFB in San Antonio, TX, and the Phillips Laboratory at Edwards AFB in California. Each of these systems is configured to process X-ray computed tomography, CT, images. The Hill AFB installation supports the aging surveillance effort on Minuteman third stage motors. The Kelly AFB system supports the acceptance inspection of airframe and engine components and torpedo housing components. The installation at Edwards AFB provides technical support to the other locations. This paper presents the development history, the system design issues, the system hardware and software architecture, and a brief description of the operational systems and their functions.
DTIC
Data Bases; Computer Aided Design; Nondestructive Tests; Digital Systems; Computer Programs; Airframes; Fabrication; Solid Propellant Rocket Engines; Data Processing; Systems Engineering; Solid Rocket Propellants

19970029936
Application of the wavelet transform for the echo signal from a rotating object
Le-Tien, T., Univ of Tasmania, Australia; Talhami, H.; Nguyen, D. T.; Martin, N. M.; Electronics Letters; January 2 1997; ISSN 0013-5194; vol. 33, no. 1, pp. 88-89; In English; Copyright; Avail: Issuing Activity

The authors present an application of wavelet analysis for the echo signal from a spinning rotor in the time-scale domain. An evaluation is also made of the measured data for two rotor speeds through analysis of their wavelet transforms.
Author (EI)
Backscattering; Electromagnetic Scattering; Radar Equipment; Rotors; Signal Processing; Target Recognition; Wavelet Analysis

19970030550
Micro-gas turbine engine materials and structures
Spearing, S. M., Massachusetts Inst of Technology, USA; Chen, K. S.; Ceramic Engineering and Science Proceedings; 1997; ISSN 0196-6219; vol. 18, no. 4 B, pp. 11-18; In English; Copyright; Avail: Issuing Activity

A program is underway to develop the technology for micro-gas turbine-generators capable of producing 50 W of electrical power in a package less than one cubic centimeter in volume. The initial goal of this project is to produce a turbine generator by micromachining single crystal silicon. The design and fabrication of such a device offers many challenges and opportunities in the field of materials and structures. The major challenges arise from the very high stress levels (approximately 1 GPa) required to achieve the necessary turbomachinery performance. The task is complicated by the need to achieve a good structural design within the constraints imposed by microfabrication processes. The major opportunities arise from the use of silicon at very small lengthscales. In particular, the use of microfabrication techniques offers the potential to control the processing-induced flaw size

such that very high strengths can be obtained. In this paper the microengine materials and structural design efforts are described, with particular emphasis on the ramifications of the device's small size.
Author (EI)
Electromechanical Devices; Gas Turbines; Structural Design; Turbine Engines; Turbogenerators

19970030653
Receptance method for the sensitivity analysis of critical speeds to rotor support stiffness
Su, Chen-Kai, Natl Taiwan Inst of Technology, Taipei, Taiwan, USA; Huang, Shyh-Chin; Journal of Engineering for Gas Turbines and Power, Transactions of the ASME; July 1997; ISSN 0742-4795; vol. 119, no. 3, pp. 736-739; In English; Copyright; Avail: Issuing Activity

A rotor system can be studied via various approaches, e.g., FEM, the transfer matrix method, etc. The receptance method has been one of the methods used for frequency analysis of rotors. The authors, herein, have shown an application of the receptance matrix for sensitivity analysis. Examples of critical speed sensitivity to support stiffness were illustrated and a computing algorithm was developed. Numerical examples proved the approach to be valuable for rotor engineers in quick evaluation and understanding of the support effects.
Author (EI)
Rotors; Sensitivity; Stiffness

19970030660 NASA Lewis Research Center, Cleveland, OH, USA
Numerical investigation of the startup transient in a wave rotor
Paxson, D. E., NASA Lewis Research Cent, USA; Journal of Engineering for Gas Turbines and Power, Transactions of the ASME; July 1997; ISSN 0742-4795; vol. 119, no. 3, pp. 676-682; In English; Copyright; Avail: Issuing Activity

The startup process is investigated for a hypothetical four-port wave rotor, envisioned as a topping cycle for a small gas turbine engine. The investigation is conducted numerically using a multi-passage, one-dimensional CFD based wave rotor simulation in combination with lumped volume models for the combustor, exhaust valve plenum, and rotor center cavity components. The simulation is described and several startup transients are presented which illustrate potential difficulties for the specific cycle design investigated. In particular it is observed that, prior to combustor light-off, or just after, the flow through the combustor loop is reversed from the design direction. The phenomenon is demonstrated and several possible modification techniques are discussed that avoid or overcome the problem.
Author (EI)
Combustion; Gas Turbines; Numerical Analysis; Rotors; Thermodynamics

19970030661
Numerical investigation of premixed combustion in wave rotors
Nalim, M. R., Natl Research Council, USA; Paxson, D. E.; Journal of Engineering for Gas Turbines and Power, Transactions of the ASME; July 1997; ISSN 0742-4795; vol. 119, no. 3, pp. 668-675; In English; Copyright; Avail: Issuing Activity

Wave rotor cycles that utilize premixed combustion processes within the passages are examined numerically using a one-dimensional CFD-based simulation. Internal-combustion wave rotors are envisioned for use as pressure-gain combustors in gas turbine engines. The simulation methodology is described, including a presentation of the assumed governing equations for the flow and reaction in the channels, the numerical integration method used, and the modeling of external components such as recirculation ducts. A number of cycle simulations are then presented that illustrate both turbulent-deflagration and detonation modes of combustion. Estimates of performance and rotor wall temperatures for the various cycles are made, and the advantages and disadvantages of each are discussed.
Author (EI)
Combustion; Numerical Analysis; Rotors; Turbines

19970030662
PI control of HSFDs for active control of rotor-bearing systems
Hathout, J. P., Cairo Univ, Egypt; El-Shafei, A.; Journal of Engineering for Gas Turbines and Power, Transactions of the ASME; July 1997; ISSN 0742-4795; vol. 119, no. 3, pp. 658-667; In English; Copyright; Avail: Issuing Activity

This paper describes the proportional integral (PI) control of hybrid squeeze film dampers (HSFDs) for active control of rotor vibrations. Recently it was shown that the automatically controlled HSFD based on feedback of rotor speed can be a very efficient device for active control of rotor vibration when passing through critical speeds. Although considerable effort has been put into the study of steady-state vibration control, there are few methods in the literature applicable to transient vibration control of rotor-

bearing systems. Rotating machinery may experience dangerously high dynamic loading due to the sudden mass unbalance that could be associated with blade loss. Transient run-up and coast down through critical speeds when starting up or shutting down rotating machinery induces excessive bearing loads at criticals. In this paper, PI control is proposed as a regulator for the HSFD system to attenuate transient vibration for both sudden unbalance and transient run-up through critical speeds. A complete mathematical model of this closed-loop system is simulated on a digital computer. Results show an overall enhanced behavior for the closed-loop rotor system. Gain scheduling of both the integral gain and the reference input is incorporated into the closed-loop system with the PI regulator and results in an enhanced behavior of the controlled system.
Author (EI)
Bearings; Proportional Control; Rotors; Shock Absorbers; Squeeze Films

19970030663
Pump instability theory using an acoustic feedback mechanism
Corley, J. E., MITRE Corp, USA; Journal of Engineering for Gas Turbines and Power, Transactions of the ASME; July 1997; ISSN 0742-4795; vol. 119, no. 3, pp. 651-657; In English; Copyright; Avail: Issuing Activity

A subsynchronous vibration problem with a large water injection pump was solved in 1974 by modifying the discharge piping transition to a long taper configuration. This paper describes a quantitative theory based upon the dynamic modeling of the pump rotor and piping system. The model successfully duplicates the experimental results of the pump instability and reproduces the subsynchronous vibration described in the original paper. The analysis results in a log decrement of the system that is dependent upon the time delay of the acoustic pulsation. It shows that the system can be driven unstable for acoustic path lengths that are much less than the quarter wavelength. The analysis also shows the log decrement is minimized when the time delay is equivalent to exactly that of one eighth wavelength of the resonant frequency of the pump.
Author (EI)
Pipelines; Pumps; Rotors; Sound Waves

19970030666
Design and test of a new axial compressor for the Nuovo Pignone heavy-duty gas turbines
Benvenuti, Erio, Nuovo Pignone S.P.A., Italy; Journal of Engineering for Gas Turbines and Power, Transactions of the ASME; July 1997; ISSN 0742-4795; vol. 119, no. 3, pp. 633-639; In English; Copyright; Avail: Issuing Activity

This axial compressor design was primarily focused to increase the power rating of the current Nuovo Pignone PGT10 Heavy-Duty gas turbine by 10 percent. In addition, the new 11-stage design favorably compares with the existing 17-stage compressor in terms of simplicity and cost. by scaling the flowpath and blade geometry, the new aerodynamic design can be applied to gas turbines with different power ratings as well. The reduction in the stage number was achieved primarily through the meridional flowpath redesign. The resulting higher blade peripheral speeds achieve larger stage pressure ratios without increasing the aerodynamic loadings. Wide chord blades keep the overall length unchanged thus assuring easy integration with other existing components. The compressor performance map was extensively checked over the speed range required for two-shaft gas turbines. The prototype unit was installed on a special PGT10 gas turbine setup, that permitted the control of pressure ratio independently from the turbine matching requirements. The flowpath instrumentation included strain gages, dynamic pressure transducers, and stator vane leading edge aerodynamic probes to determine individual stage characteristics. The general blading vibratory behavior was proved fully satisfactory. With minor adjustments to the variable stator settings, the front stage aerodynamic matching was optimized and the design performance was achieved.
Author (EI)
Compressors; Gas Turbines; Shafts (Machine Elements); Strain Gages

19970031063 ISRO Satellite Centre, Peenya, Communication System Group, Bangalore, India
L and C band wide beam width antenna for remote controlled pilotless aircraft
Pal, S., ISRO Satellite Centre, Peenya, India; Lakshmeesha, V. K., ISRO Satellite Centre, Peenya, India; Barnwal, S. K., ISRO Satellite Centre, Peenya, India; Journal of Spacecraft Technology; Jul. 1997; Volume 7; No. 2, pp. 54-60; In English; Also announced as 19970031056; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

L and C band self phased, fractional turn, 3(lambda)/4 wavelength quadarifilar helical antennae have been developed for airborne applications. The developed antennae are wide beamwidth, light weight and small size units providing circular polarization

over a broad angular region. Also, a built-in lightning protection mechanism has been incorporated. The development is PCB technology based.
Author
C Band; Pilotless Aircraft; Antenna Arrays; Remote Control; Ultrahigh Frequencies; Airborne Equipment; Beams (Radiation); Circular Polarization

19970031131 NASA Lewis Research Center, Cleveland, OH USA
Structures Division *Annual Report, 1995*
Jul. 1997; 72p; In English
Contract(s)/Grant(s): RTOP 505-63-5B
Report No.(s): NASA-TM-107300; E-10385; NAS 1.15:107300; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The NASA Lewis Research Center Structures Division is an international leader and pioneer in developing new structural analysis, life prediction, and failure analysis related to rotating machinery and more specifically to hot section components in air-breathing aircraft engines and spacecraft propulsion systems. The research consists of both deterministic and probabilistic methodology. Studies include, but are not limited to, high-cycle and low-cycle fatigue as well as material creep. Studies of structural failure are at both the micro- and macrolevels. Nondestructive evaluation methods related to structural reliability are developed, applied, and evaluated. Materials from which structural components are made, studied, and tested are monolithics and metal-matrix, polymer-matrix, and ceramic-matrix composites. Aeroelastic models are developed and used to determine the cyclic loading and life of fan and turbine blades. Life models are developed and tested for bearings, seals, and other mechanical components, such as magnetic suspensions. Results of these studies are published in NASA technical papers and reference publication as well as in technical society journal articles. The results of the work of the Structures Division and the bibliography of its publications for calendar year 1995 are presented.
Author
Structural Failure; Dynamic Structural Analysis; Structural Analysis; Air Breathing Engines; Ceramic Matrix Composites; Engine Parts; Failure Analysis; Gas Turbine Engines; Nondestructive Tests; Propulsion System Performance; Spacecraft Propulsion; Structural Reliability

13
GEOSCIENCES

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

19970029011 Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid, Spain
Strength and fatigue testing of large size wind turbines rotors, Volume 2, Full size natural vibration and static strength test, a reference case
Arias, F., Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Spain; Soria, E., Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Spain; Dec. 1996; 127p; In English
Report No.(s): CIEMAT-816; DE97-728463; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

This report shows the methods and procedures selected to define a strength test for large size wind turbine, anyway in particular it application on a 500 kW blade and it results obtained in the test carried out in july of 1995 in Asinel's test plant (Madrid). Henceforth, this project is designed in an abbreviate form with the acronym SFAT.
Author(DOE)
Fatigue Tests; Rotors; Mechanical Properties

19970029144 Arete Associates, Inc., Arlington, VA USA
Development of an EO Wave Imaging System on PELICAN: A Remotely Piloted Aircraft *Final Report*
Selwyn, Philip, Arete Associates, Inc., USA; Jendro, Larry, Arete Associates, Inc., USA; Farruggia, Guy, Arete Associates, Inc., USA; May 30, 1997; 29p; In English
Contract(s)/Grant(s): N00014-97-C-0011
Report No.(s): AD-A327218; ARE-575-004-TR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this report Arete proposes the development of an electro-optical wave imaging system and its installation on the Pelican remotely piloted aircraft. This system would collect a time series of electro-optical images over a precisely fixed area of the ocean

to provide wave spectra which would be analyzed to determine important coastal ocean parameters such as bathymetry, wave characteristics and surface currents. The coastal-zone of the ocean is spatially and temporally complex, exhibiting a number of physical processes occurring simultaneously. Specific items of interest include ocean swell, wind-driven waves, mean and variance in turbulent fluxes, breaking waves and currents. in the coastal zone, the situation is complicated by significant spatial gradients that cause inhomogeneities on relatively small spatial scales. Although small on geophysical scales, these coastal features are too extensive and complex to be measured well by a small number of research vessels or buoys, yet they are too small and vary too rapidly to be measured by satellite sensors. What is needed is an instrument system that can measure many of the required parameters, but is small and lightweight so that it can be mounted in an aircraft and therefore cover a wide area of interest over relatively long span of time.
DTIC
Electro-Optics; Remotely Piloted Vehicles; Images; Aircraft Instruments; Measuring Instruments; Coasts; Oceans

19970029453 National Renewable Energy Lab., Golden, CO USA
Effects of turbulence on power generation for variable-speed wind turbines
Muljadi, E., National Renewable Energy Lab., USA; Butterfield, C. P., National Renewable Energy Lab., USA; Buhl, M. L., Jr., National Renewable Energy Lab., USA; Nov. 1996; 11p; In English; 16th; American Society of Mechanical Engineers Wind Energy Symposium, 6-9 Jan. 1997, Reno, NV, USA
Contract(s)/Grant(s): DE-AC36-83CH-10093
Report No.(s): NREL/CP-440-21670; CONF-970135-2; DE97-000073; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

One of the primary advantages of variable-speed wind turbines over fixed-speed turbines should be improved aerodynamic efficiency. With variable-speed generation, in order to maintain a constant ratio of wind speed to tip speed, the wind turbine changes rotor speed as the wind speed changes. In this paper we compare a stall-controlled, variable-speed wind turbine to a fixed-speed turbine. The focus of this paper is to investigate the effects of variable speed on energy capture and its ability to control peak power. We also show the impact of turbulence on energy capture in moderate winds. In this report, we use a dynamic simulator to apply different winds to a wind turbine model. This model incorporates typical inertial and aerodynamic performance characteristics. From this study we found a control strategy that makes it possible to operate a stall-controlled turbine using variable speed to optimize energy capture and to control peak power. We also found that turbulence does not have a significant impact on energy capture.
DOE
Aerodynamic Characteristics; Turbulence Effects; Rotor Speed; Variations

19970030074 Universidade Federal de Paraiba, Dept. of Atmospheric Sciences, Brazil
Relative Contributions of Energy and Aerodynamic Terms to Reference Crop Evapotranspiration in Different Moisture Climates
Kumar, Kamada Karuna, Universidade Federal de Paraiba, Brazil; deFatimaBezerra, Virginia, Universidade Federal de Paraiba, Brazil; Ninth Brazilian Congress of Meteorology; 1996; Volume 1, pp. 484-488; In English; Also announced as 19970030071; No Copyright; Avail: Issuing Activity (Sociedade Brasileira de Meteorologia, 21949-900 Rio de Janeiro RJ, Brazil), Hardcopy, Microfiche

Penman's combination method is widely used for the determination of potential (reference crop) evapotranspiration. In using Penman's equation various approximations are often made since the data necessary is not always available. In the present paper Penman's equation is used to evaluate monthly values of reference crop evapotranspiration at eight stations (in the same latitude belt) representing different moisture climates in north India. The relative contributions of the energy and aerodynamic terms to reference crop evapotranspiration at the stations are discussed. It is found that in the evaluation of reference crop evapotranspiration the energy term should be determined accurately in the perhumid and humid regions while in the arid and semiarid regions greater attention should be paid to the computation of the aerodynamic term.
Author
Evapotranspiration; Farm Crops; Aerodynamics; Moisture; Climate; Energy

19970030193 Los Alamos National Lab., NM USA
Energy management subsystem *Final Report*
Wightman, C. W., Los Alamos National Lab., USA; [1997]; 21p; In English
Contract(s)/Grant(s): W-7405-eng-36

Report No.(s): LA-SUB-93-244; DE97-003574; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

In todays environment-conscious world, increasing levels of automotive emissions have been recognized as a major source of pollutants and greenhouse gases. Despite increasingly stringent tailpipe emission standards, the increased use of the automobile has more than offset the lowered per-vehicle emissions. Consequently, there is a great deal of interest in so-called zero-emission vehicles, such as electric and hybrid-electric automobiles. Although very attractive in terms of emissions, these vehicle present some design challenges which are not generally part of conventional automotive design. One such challenge is the development of an effective energy management strategy for the vehicle. While a conventional automobile has an engine whose power output far exceeds the average vehicle needs, hybrid electric vehicles generally have very limited energy reserves and efficiency in the use of these reserves is paramount if acceptable overall performance is to be achieved. Man aspects of the vehicle design (such as aerodynamics, powertrain design, gross weight, etc.) strongly influence the overall vehicle efficiency. However, the actual performance achieved by any given driver is strongly dependent on his or her driving skills. One way to reduce the effect of differences in driving skills is to provide for automatic accelerator control, permitting the vehicle to be driven in an efficient manner without necessitating extensive driver training. This report describes an accelerator/brake control systems developed for use on the Zia Roadrunner New Mexico Tech's entry in the 1993 Sunrayce for solar-electric hybrid vehicles.
DOE
Automatic Control; Electric Hybrid Vehicles; Electric Motor Vehicles; Electric Automobiles; Pollution Control; Aerodynamics; Contaminants; Combustion Products

14
LIFE SCIENCES

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

19970028849 Naval Aerospace Medical Research Lab., Pensacola, FL USA
Development and Implementation of the Aircrew Modified Equipment Leading to Increased Accommodation (AMELIA) Program ***Interim Report, 1994-1996***
Meyer, L. G., Naval Aerospace Medical Research Lab., USA; Pokorski, T. L., Naval Aerospace Medical Research Lab., USA; Smith, D. G., Naval Aerospace Medical Research Lab., USA; Ortel, B. E., Naval Aerospace Medical Research Lab., USA; Oct. 07, 1996; 90p; In English
Report No.(s): AD-A327030; NAMRL-SR-96-3; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Current naval aviation life Support equipment (ALSS) was designed to accommodate the 5th through the 95th percentile size of the 1964 U.S. male population. Since a large portion of the present U.S. female population falls outside this range, problems occur in fitting flight clothing and ALSS for female naval aviators. This report on Aircrew Modifications Leading to Increased Accommodation describes a fleet-wide survey of all naval female pilots, flight officers, and enlisted aircrew with regard to ALSS problems. The survey response rate was 67%. ALSS fit problems in naval aviation were identified and recommendations for solving these problems were provided to the Naval Air Systems Command. The top five ALSS problem areas identified b y respondents in order of importance were helmet, urine-collection devices, torso harness, survival vest, and anti-exposure coverall.
DTIC
Flight Crews; Protective Clothing; Life Support Systems; Aircraft Pilots

19970028923 Armstrong Lab., Brooks AFB, TX USA
Pilot Performance Variables ***Interim Report, Aug. 1996 - Mar. 1997***
King, Raymond E., Armstrong Lab., USA; Siem, Frederick M., Armstrong Lab., USA; Zelenski, Warren E., Armstrong Lab., USA; Bates, Mark J., La Verne Univ., USA; Colwell, Catherine D., La Verne Univ., USA; Mar. 1997; 112p; In English
Contract(s)/Grant(s): AF Proj. 7184
Report No.(s): AD-A326600; AL/CF-TR-1997-0059; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This review integrates some of the many studies on pilot performance for selection and screening. Pilot performance studies have come a long way as the aviation systems and the roles of the aviator have evolved. No single construct, or operationalization of variables, fully addresses pilot performance. Rather, a multi-disciplinary and multi-modal approach, using significant developments from recent studies, holds the most promise. Developments in information processing theory, at the individual and group levels, combined with findings from safety studies offer potential future criteria of operational performance. In the past, the use of these variables was limited by the difficulty of measuring their impact on performance. Inter-disciplinary efforts, longitudinal studies, and technological advances (such as simulators and computers) enable researchers to better measure these variables. (The

combination of previous/current pilot training measures, process-oriented intra/inter-personal variables, safety studies, more functionally and process-oriented personality inventories, and advances in technology/research methods provide opportunities for stronger measures and, ultimately, predictors of pilot performance.)
DTIC
Aircraft Pilots; Pilot Performance; Pilot Training; Information Processing (Biology); Performance Prediction

19970028977 Army Aeromedical Research Lab., Fort Rucker, AL USA
Aircraft Multifunction Display and Control Systems: A New Quantitative Human Factors Design Method for Organizing Functions and Display Contents ***Final Report***
Francis, Gregory, Purdue Univ., USA; Reardon, Matthew J., Army Aeromedical Research Lab., USA; Apr. 1997; 46p; In English
Contract(s)/Grant(s): 3M1-62787-A-879
Report No.(s): AD-A327332; USARRL-97-18; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objectives of this study were to review the current state of aircraft multifunction display and control system (MPDCS) design methods and develop a quantitative method of designing MFDCSs that incorporate important human factors issues. Reports in the literature indicate that MFDCS design can influence flight performance. However, current design methods rely primarily on the designer's intuition and experience. MFDCSs in aircraft cockpits use computer-generated graphics and symbology that have integrated and largely replaced the myriad discrete electromechanical flight instruments found in older aircraft. While much is known about the physical and visual properties of MFDCSs, less is known about which human factors are important for their design and use. MFDCSs may result in greater workload if the distribution of virtual instruments, graphical and text data, and control functions in an n-dimensional structure of display pages places excessive cognitive and psychomotor demands on pilots during either routine or emergency situations. A quantitative method was developed, involving the derivation of a weighted sum of separate cost functions, each of which incorporates the effects of an arbitrary number of human factors and MFDCS design guidelines. The method models, using a high level of abstraction, a pilot's search for specific information or functions among alternative hierarchies of MFDCS display pages. An annealing algorithm was proposed as an effective numerical method for finding the display page hierarchy that minimizes the composite cost function.
DTIC
Flight Control; Human Factors Engineering; Display Devices; Control Systems Design; Electromechanical Devices; Flight Instruments

19970029143 CHI Systems, Inc., Lower Gwynedd, PA USA
SH-60R Operator Machine Interface Enhancement (SHOMIE) ***Monthly Report, 1 Apr. - 31 May 1997***
Glenn, Floyd, CHI Systems, Inc., USA; Jun. 13, 1997; 4p; In English
Contract(s)/Grant(s): N00421-97-C-1133
Report No.(s): AD-A327221; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

A systematic approach, designated SH-60R operator Machine Interface Enhancement (SHOMIE), is proposed for developing decision aid enhancements to the SENSO and ATO crewstations of the SH-60R aircraft which is currently under development by the Navy. The methodology begins with determination of functional performance requirements via a technique based primarily, but not exclusively, on cognitive task analysis. Cognitive performance limitations are determined both analytically and empirically and then used to derive functional requirements for decision aid concepts to overcome the identified limitations. Relevant software and algorithmic techniques for realizing the desired functionality are then derived from an evaluation of viable candidates obtained from a taxonomic analysis of aiding technologies. Finally, the decision aid concepts are specified as structured architectural designs which are then implemented as software prototypes.
DTIC
Computer Programs; Human-Computer Interface; Aircraft Pilots

19970029371 Defence Science and Technology Organisation, Air Operations Div., Salisbury, Australia
A Generic Architecture for Crew Assistant Systems
Urlings, Pierre J. M., Defence Science and Technology Organisation, Australia; Zuidgeest, Rene G., National Aerospace Lab., Netherlands; Jul. 1997; 12p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

A crew assistant is an on-board automated system that supports an aircraft crew in performing its tasks. Aircraft crews are currently confronted with numerous displays and complex controls in their cockpit. An overwhelming amount of multi-source data is offered while simultaneously control over the aircraft and its systems has to be maintained. This may Iead to situations of high workload in which non-optimal decisions are made. Crew assistant systems are planned to reduce this problem and hence

improve efficiency and flight safety. They are expected to rely heavily on Advanced Information Processing (AIP) technologies to organize data and control flow in such a way that the crew is provided with concise and relevant information. At the same time the crew's control efforts will be considerably reduced. This will enable the crew to concentrate on essentials and to make decisions more effective Several developments exist in this area. Pioneer programmes are the US 'Pilot's Associate' the British 'Mission Management Aid' the French 'Copilote Electronique' and the German 'Cockpit Assistant System.' These programs go by different names but all aim at the automation of routine tasks and the provision of effective aids to the crew problem solving and task management. The architectures developed in these programmes have many elements in common but suggest a more generic architecture. Another common element of these programmes is that they consider AIP as key technology for their successful implementation. AIP provides technologies able to handle the complex interaction between crew, crew assistant, aircraft systems and sensors. This paper focuses in particular on these two aspects: a generic crew assistant architecture and the application of AIP technology. In section 2 the operational environment is described in which a crew assistant is to be embedded. Section 3 introduces a generic crew assistant architecture which is independent of any type of aircraft or operation. Section 4 proposes the application of AIP in general and of multi-agent systems in particular as a key technology for successful implementation of a crew assistant. Throughout the paper, the crew assistant is illustrated by an application of a single-pilot military aircraft, but the concept is also relevant to multi-crew or civil aircraft.
Author
Information Systems; Information Flow; Flight Safety; Flight Operations; Flight Crews; Display Devices; Data Processing; Civil Aviation; Cockpits

19970029372 Elektroniksystem- und Logistik G.m.b.H., Avionics-Fixed Wing Aircraft, Munich, Germany
Perspectives of Crew Assistance in Military Aircraft Through Visualizing, Planning and Decision Aiding Functions
Schulte, Axel, Elektroniksystem- und Logistik G.m.b.H., Germany; Kloeckner, Wolfgang, Elektroniksystem- und Logistik G.m.b.H., Germany; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Due to increasing demands put on crews of military aircraft, effective cockpit systems will be required in order to reduce workload and to improve crew performance. This paper presents various approaches to crew assistance in tactical flight missions. The underlying tasks are tactical decision making, low-level flight planning and flight guidance. The integration of the Tactical Situation System as part of a knowledge based crew assistant and a flight guidance display system incorporating sensor and synthetic vision components offer a promising solution to improve the situational awareness of the crew. Respective prototypes have been successfully tested and evaluated in a simulated environment as well as by flight trials.
Author
Knowledge Based Systems; Human Performance; Guidance Sensors; Flight Plans; Flight Crews; Cockpits

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MATHEMATICAL AND COMPUTER SCIENCES

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

19970028851 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Comparison of Several Dissipation Algorithms for Central Difference Schemes *Final Report*
Swanson, R. C., NASA Langley Research Center, USA; Radespiel, R., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Turkel, E., Institute for Computer Applications in Science and Engineering, USA; Aug. 1997; 32p; In English; 13th; Computational Fluid Dynamics, 27 Jun. - 2 Jul. 1997, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS1-19480; RTOP 505-90-52-01
Report No.(s): NASA-CR-201726; NAS 1.26:201726; ICASE-97-40; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Several algorithms for introducing artificial dissipation into a central difference approximation to the Euler and Navier Stokes equations are considered. The focus of the paper is on the convective upwind and split pressure (CUSP) scheme, which is designed to support single interior point discrete shock waves. This scheme is analyzed and compared in detail with scalar and matrix dissipation (MATD) schemes. Resolution capability is determined by solving subsonic, transonic, and hypersonic flow problems. A finite-volume discretization and a multistage time-stepping scheme with multigrid are used to compute solutions to the flow

equations. Numerical results are also compared with either theoretical solutions or experimental data. For transonic airfoil flows the best accuracy on coarse meshes for aerodynamic coefficients is obtained with a simple MATD scheme.
Author
Navier-Stokes Equation; Shock Waves; Internal Waves; Flow Equations; Finite Volume Method; Differential Equations; Aerodynamic Coefficients; Airfoils

19970029349 Lockheed Martin Tactical Aircraft Systems, Fort Worth, TX USA
Information: The Warfighter's Edge. The Joint Strike Fighter (JSF) and System-of-Systems (SoS)
Williams, Michael A., Lockheed Martin Tactical Aircraft Systems, USA; Collier, Larry G., Lockheed Martin Tactical Aircraft Systems, USA; Jul. 1997; 12p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Complete autonomous mission capability for tactical aircraft is no longer affordable nor necessary in view of the SoS concept. The JSF will rely upon national, theater, and tactical-level ISR to provide long-range target detection, location, and identification. Onboard systems will employ cues from the off-board collectors but will still be required to provide targeting and weapon employment capability as a result of latency and accuracy issues with ISR collectors. However, the resulting JSF on-board sensors will be much less complex in terms of power-aperture product, aperture complexity and/or system sensitivity: the current cost drivers in avionics. Total weapon system performance will be maintained through correlation and fusion of off-board information with onboard sensor data. In effect, off-board data, correlation, and fusion technology will enable a smaller and less complex on-board sensor system to perform like that of a much higher performance/cost system. Use of wingman data will allow on-board systems to be designed for less severe simultaneous mode capabilities. Lower cost, non-interferometer, apertures on multiple aircraft will be managed to provide highly accurate range and bearing data. The implementation of a SoS concept will enable an affordable JSF which can be procured in large enough numbers to replace end-of-life aircraft for the US and NATO allies.
Author
Aircraft Pilots; Avionics; Complex Systems; Cost Reduction; Weapon Systems; Target Acquisition

19970029363 Naval Air Warfare Center, Weapons Div., China Lake, CA USA
Rapid Targeting and Real-Time Response: The Critical Links for Effective Use of Combined Intelligence Products in Combat Operations
Searle, Danny, Naval Air Warfare Center, USA; Kirchner, Rick, Naval Air Warfare Center, USA; Fincher, Ted, Naval Air Warfare Center, USA; Armogida, Frank, Naval Air Warfare Center, USA; Jul. 1997; 8p; In English; Also announced as 19970029347; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

A variety of advanced technology projects have demonstrated the key components required to provide rapid targeting for a real-time response. Forward Hunter (led by NAWCWPNS) and Goldpan (led by the Air Force's Aeronautical Systems Center) are examples of Real-Time Information into the Cockpit/Offboard Targeting (RTIC/OT) demonstrations. These programs have shown the value of providing real-time mission updates (based on national offboard signals and imagery intelligence) to shooters pursuing time-critical targets. All these programs employed national exploitation systems and source material products to show that RTIC/OT can increase mission effectiveness, enhance survivability, and increase operational flexibility against time-critical fixed and mobile targets. Each demonstration has focused on different aspects of critical offboard targeting technologies, such as multisource national/theater intelligence fusion, rapid targeting, near-real-time mission replanning, data dissemination, and onboard processing.
AIAA
Onboard Data Processing; Real Time Operation; Intelligence; Imagery; Data Processing; Cockpits; Combat

19970029995 NASA Hugh L. Dryden Flight Research Center, Edwards, CA, USA
Development and application of an integrated multidisciplinary analysis capability
Gupta, K. K., NASA Dryden Flight Research Cent, USA; International Journal for Numerical Methods in Engineering; February 15 1997; ISSN 0029-5981; vol. 40, no. 3, pp. 533-550; In English; Copyright; Avail: Issuing Activity

The paper presents details of a numerical formulation and associated general-purpose finite element (FE) software developed for the integrated aeroelastic and aeroservoelastic (ASE) analysis of complex engineering systems, encompassing such disciplines as structures, unsteady aerodynamics, and feedback controls. A linear analysis, involving panel methods for derivation of unsteady aerodynamic forces, is achieved by transforming the equations of motion from the frequency to the Laplace domain and formulating a state-space matrix relationship, the related matrices being further augmented by the analog elements such as actuators and filters as well as digital or analog controllers. For non-linear problems, FE-based structural and computational fluid dynamics (CFD) solutions are adopted for the relevant analyses. Numerical results pertaining to a number of practical problems,

obtained by utilizing the associated computer program, are compared to those derived from relevant flight and wind tunnel tests as well as other analyses, and they are presented here in some detail. Such results, involving damping and frequency responses, relate to the stability characteristics of the aerospace vehicles and testify to the efficacy of the present solution procedure.
Author (EI)
Aerodynamic Forces; Aerodynamics; Computer Programs; Equations of Motion; Feedback Control; Finite Element Method; Numerical Analysis; Structural Analysis; Unsteady Aerodynamics

19970030254 Naval Postgraduate School, Dept. of Aeronautics and Astronautics, Monterey, CA USA
Application of Neural Network to Reconfiguration of Damaged Aircraft
Collins, Daniel J., Naval Postgraduate School, USA; Sep. 1997; 15p; In English; Also announced as 19970030248; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

Although the title of this lecture refers to using Artificial Neural Networks (ANN) in reconfiguration algorithms of damaged aircraft, the analysis applies in general to the identification and control of non-linear time-varying dynamical systems. This lecture addresses the problem of emulation and control of a fighter aircraft by means of ANN. Four models for describing non-linear MIMO dynamical systems are described. Based on this description a combined feedforward and recurrent neural network is structured to emulate the system. A procedure is given to emulate multiple systems in a single neural network. By the introduction of a minimal realization of the network, the complexity of the network is greatly reduced without degradation of the operating performance of the network. The aircraft model used in the demonstration of the neural network is the longitudinal node of the F/A-18A fighter aircraft. The work developed here is based on Shakar Dror.
Author
Damage; Fighter Aircraft; Algorithms; Nonlinearity; Dynamical Systems; Aircraft Models; Aircraft Control

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PHYSICS

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

19970028796 Fermi National Accelerator Lab., Batavia, IL USA
M(sub W) measurement at the Tevatron with high luminosity
Giele, W. T., Fermi National Accelerator Lab., USA; Keller, S., Fermi National Accelerator Lab., USA; [1996]; 4p; In English; DPF 1996: Meeting of the Division of Particles and Fields of the American Physical Society (APS), 10-15 Aug. 1996, Minneapolis, MN, USA
Contract(s)/Grant(s): DE-AC02-76CH-03000
Report No.(s): FNAL/C-96/307-T; CONF-960812-54; DE97-050040; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Currently, the mass of the (ital W)-boson ((ital M(sub W))) is measured at the Tevatron from the transverse mass distribution ((ital M(sub T))). At higher luminosities, the uncertainty with which (ital M(sub W)) can be extracted will degrade. We present an alternate method to measure (ital M(sub W)) at the Tevatron with high luminosity from a direct comparison of the (ital W) and (ital Z) distributions.
DOE
Luminosity; Bosons; Aerodynamic Stability

19970029054 Greenwich Univ., School of Computing and Mathematical Sciences, London, UK
Testing a Linear Propagation Module on Some Acoustic Scattering Problems
Djambazov, G. S., Greenwich Univ., UK; Lai, C. H., Greenwich Univ., UK; Pericleous, K. A., Greenwich Univ., UK; Second Computational Aeroacoustics (CAA) Workshop on Benchmark Problems; Jun. 1997, pp. 221-229; In English; Also announced as 19970029035; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

Finite volume discretization of the Linearized Euler Equations on a fully staggered computational grid results in an efficient semi-implicit numerical scheme which can be used in the 'near field' of aerodynamic noise problems.
Author
Acoustic Scattering; Finite Volume Method; Computational Grids; Computational Fluid Dynamics; Discretization (Mathematics); Aerodynamic Noise

19970029059 Duke Univ., Dept. of Mechanical Engineering and Materials Science, Durham, NC USA

A Variational Finite Element Method for Computational Aeroacoustic Calculations of Turbomachinery Noise

Hall, Kenneth C., Duke Univ., USA; Second Computational Aeroacoustics (CAA) Workshop on Benchmark Problems; Jun. 1997, pp. 269-278; In English; Also announced as 19970029035; Copyright Waived (NASA); Avail: CASI; A02, Hardcopy; A04, Microfiche

A variational method for computing the unsteady aeroacoustic response of turbomachinery blade rows to incident vortical gusts is presented. A variational principle which describes the harmonic small disturbance behavior of the full potential equations about a uniform mean flow is developed. Four-node isoparametric finite elements are used to discretize the variational principle, and the resulting discretized equations are solved efficiently using LU decomposition. Results computed using this technique are found to be in excellent agreement with those obtained using semi-analytical methods.

Author

Finite Element Method; Aeroacoustics; Turbomachinery; Turbine Blades; Variational Principles; Computational Grids; Aerodynamic Noise

19970029060 Pennsylvania State Univ., Dept. of Aerospace Engineering, University Park, PA USA

A Parallel Simulation of Gust/Cascade Interaction Noise

Lockard, David P., Pennsylvania State Univ., USA; Morris, Philip J., Pennsylvania State Univ., USA; Second Computational Aeroacoustics (CAA) Workshop on Benchmark Problems; Jun. 1997, pp. 279-287; In English; Also announced as 19970029035; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

The problem of an incompressible vortical gust encountering a cascade of flat plate airfoils is investigated using parallel computers. The Euler equations are used to model the flow. A high-accuracy, finite-difference algorithm is used to solve the equations in a time accurate manner. Two frequencies of the incident gust are investigated. The sensitivity of the solution to the boundary conditions and run times are examined. In addition, the influence of the spacing between the blades is demonstrated. Although the use of parallel computers significantly reduces the turnaround time for these calculations, the difficulties in properly specifying the boundaries and obtaining a periodic state still makes them challenging.

Author

Finite Difference Theory; Computational Fluid Dynamics; Aerodynamic Noise; Parallel Processing (Computers); Runge-Kutta Method; Airfoils; Aeroacoustics

19970029313 Colorado Univ., Dept. of Chemistry and Biochemistry, Boulder, CO USA

Atomic Layer Control of Thin Film Growth Using Binary Reaction Sequence Chemistry

George, Steven M., Colorado Univ., USA; Jun. 1997; 17p; In English

Contract(s)/Grant(s): N00014-92-J-1353

Report No.(s): AD-A327210; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Our research is focusing on the atomic layer control of thin film growth. Our goal is to deposit films with precise control of thickness and conformality on both flat and high aspect ratio structures. Atomic layer control of growth is crucial for many technologies that require nanoscale deposition techniques to fabricate ultrathin and conformal films with thicknesses from 10-100 A. Examples of these films are ultrathin gate oxides, high dielectric constant films, conformal transparent conducting layers and ultrathin diffusion barriers.

DTIC

Thin Films; Binary Mixtures; Chemical Reactions; Thickness; High Aspect Ratio; Atoms

19970030888

Quantum transport through atomic wires

Wan, C. C., McGill Univ, Canada; Mozos, Jose-Luis; Taraschi, Gianni; Wang, Jian; Guo, Hong; Applied Physics Letters; July 21 1997; ISSN 0003-6951; vol. 71, no. 3, pp. 419-421; In English; Copyright; Avail: Issuing Activity

The quantum transport properties of long atomic wire consisting of 3D incoming and outgoing jellium leads and an atomic chain with several Al atoms are studied. Results show that atomic chain of the wire breaks the vacuum barrier when there is no atoms between the leads, and this gives a dramatic increase of the conductance. Quantized conductance is observed when there are more than one atom in the atomic chain.

Author (EI)

Atomic Physics; Electrical Resistance; Electron Transfer; Matrices (Mathematics); Quantum Theory; Superconductors (Materials); Supersonic Commercial Air Transport; Transport Properties; Wire

17
SOCIAL SCIENCES

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

19970028786 Naval Postgraduate School, Monterey, CA USA
Instructional Design of Computer-Based Training
Foster, Robert W., Naval Postgraduate School, USA; Price, Alfred B., Jr., Naval Postgraduate School, USA; Dec. 1996; 108p; In English
Report No.(s): AD-A327386; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The goal of this research is to combine the principles of instructional design and computer technology in order to produce a multimedia computer based trainer for the Aviation Night Vision Image System and Heads up Display (ANVIS/HUD). The technological advances in night vision goggles like the ANVIS/HUD system have permitted aircrews to accomplish numerous night mission tasks which they were not previously capable of completing. Increase in mission tasking requires the operators of the ANVIS/HUD system to obtain a large amount of ANVIS/HUD training to ensure safety of personnel and equipment as well as mission success. The Department of the Navy's training budget is being reduced and the need for unconventional training methods to augment the cockpit and classroom is essential. The use of computer based training provides the technology to achieve this training requirement. by providing a means to apply innovative instructional design principles and multimedia computer technology, the training of the war fighters is expected to be accomplished both effectively and efficiently thus saving lives and money. DTIC
Computer Assisted Instruction; Night Vision; Goggles; Training Devices; Flight Crews; Flight Simulators; Head-Up Displays; Design Analysis; Computer Systems Design

18
SPACE SCIENCES

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

19970030247 Los Alamos National Lab., Theoretical Div., NM USA
Tsunami Produced by the Impacts of Small Asteroids
Hills, Jack G., Los Alamos National Lab., USA; Mader, Charles L., Los Alamos National Lab., USA; Annals of the New York Academy of Sciences; 1997; Volume 822, pp. 381-394; In English; Also announced as 19970030205; Original contains color illustrations; Copyright; Avail: Issuing Activity (New York Academy of Sciences, 2 East 63rd Street, New York, NY 10021), Hardcopy, Microfiche

The fragmentation of a small asteroid in the atmosphere greatly increases its cross section for aerodynamic braking, so ground impact damage (craters, earthquakes, and tsunami) from a stone asteroid is nearly negligible if it is less than 200 meters in diameter. A larger one impacts the ground at nearly its velocity at the top of the atmosphere producing considerable impact damage. The protection offered by Earth's atmosphere is insidious in that smaller, more frequent impactors such as Tunguska only produce air blast damage and leave no long term scars on the Earth's surface, while objects 2.5 times larger than it, which hit every few thousand years, cause coherent destruction over many thousands of kilometers of coast. Smaller impactors give no qualitative warning of the enormous destruction wrought when an asteroid larger than the threshold diameter of 200 meters hits an ocean. A water wave generated by an impactor has a long range because it is two-dimensional, so its height falls off inversely with distance from the impact. When the wave strikes a continental shelf, its speed decreases and its height increases to produce tsunamis. The average runup in height between a deep-water wave and its tsunami is more than an order of magnitude. Tsunamis produce most of the damage from asteroids with diameters between 200 meters and 1 km. An impact anywhere in the Atlantic by an asteroid 400 meters in diameter would devastate the coasts on both sides of the ocean by tsunami over 100 meters high. An asteroid 5 km in diameter hitting in mid Atlantic would produce tsunami that would inundate the entire upper East Coast of the USA to the Appalachian Mountains. Studies of ocean sediments may be used to determine when coastal areas have been hit by tsunamis in the past. Tsunami debris has been found to be associated with the Cretaceous-Tertiary impact and should be detectable for smaller impacts. Author
Aerial Explosions; Aerodynamic Brakes; Asteroids; Earth Atmosphere; Fragmentation; Impact Damage; Water Waves

Subject Term Index

A

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