11 Chemistry and Materials 61

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

12 Engineering 63

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.

13 Geosciences 70

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

14 Life Sciences 71

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

15 Mathematical and Computer Sciences 73

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.

16 Physics 77

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

17 Social Sciences 81

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.

18 Space Sciences N.A.

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

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Author Index **PA–1**

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Appendix

Select **Appendix** for important information about NASA Scientific and Technical Information (STI) Office products and services, including registration with the NASA Center for AeroSpace Information (CASI) for access to the NASA CASI TRS (Technical Report Server), and availability and pricing information for cited documents.

Typical Report Citation and Abstract

ACCESSION NUMBER ↓

DOCUMENT ID NUMBER → **19960021053;** 96N24540 NASA Langley Research Center, Hampton, VA USA. ← CORPORATE SOURCE

TITLE → **An Extended Compact Tension Specimen for Fatigue Crack Propagation and Fracture**

AUTHORS → Piascik, R. S., NASA Langley Research Center, USA; Newman, J. C., Jr., NASA Langley Research Center, USA; ← AUTHORS' AFFILIATION

PUBLICATION DATE → Mar. 1996, pp. 16; In English

CONTRACTS/GRANTS → Contract(s)/Grant(s): RTOP 538–02–10–01

REPORT NO.(S) → Report No.(s): NASA–TM–110243; NAS 1.15:110243; No Copyright; Avail: CASI A03, Hardcopy; A01, Microfiche ← AVAILABILITY AND PRICE CODE

ABSTRACT → An extended compact tension specimen, EC(T) has been developed for fatigue and fracture testing. Documented herein are stress-intensity factor and compliance expressions for the EC(T) specimen.

ABSTRACT AUTHOR → Author

SUBJECT TERMS → *Crack Propagation; Stress Intensity Factors; Fatigue (Materials)*

19960042539 NASA Langley Research Center, Aerothermodynamics Branch., Hampton, VA USA

DSMC simulations of OREX entry conditions

Moss, James N., NASA Langley Research Center, USA; Gupta, Roop N., NASA Langley Research Center, USA; Price, Joseph M., NASA Langley Research Center, USA; Aug. 24, 1996; 6p; In English; 20th; InterNational Symposium on Rarefied Gas Dynamics, August 19-24, 1996, Beijing, China

Report No.(s): NASA-TM-111621; NAS 1.15:111621; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Results of direct simulation Monte Carlo (DSMC) solutions are presented for the Japanese Orbital Reentry Experiment (OREX) vehicle, a 50 deg half-angle spherically blunted cone with a nose radius of 1.35 m and a base diameter of 3.4 m. The flow conditions simulated are those for entry into the Earth's atmosphere at a nominal velocity of about 7.4 km/s and zero incidence. Calculations are made for the higher altitude portion of entry, encompassing the transitional flow regime (altitudes of 200 to 80 km). Comparisons with flight measured values are made for axial acceleration, surface pressure, and stagnation point heating.

Author

Monte Carlo Method; Reentry Vehicles; Computerized Simulation; Space Flight; Flight Simulation; Reentry Effects; Aerodynamic Heating; Pressure; Acceleration (Physics)

19960045617 Martin Marietta Aerospace, Astronautics., Denver, CO USA

Satellite domain analysis report for reUSAble software architecture for spacecraft *Final Report*

Flanagan, Amy, Martin Marietta Aerospace, USA; Moultrie, Benjamin, Martin Marietta Aerospace, USA; Dec. 1995; 63p; In English

Contract(s)/Grant(s): F29601-94-C-0114; AF Proj. 2181

Report No.(s): AD-A305242; PL-TR-95-1007; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

The ReUSAble Software Architecture for Spacecraft (RSAS) project has as an objective, the of an engineering 'Workbench' which will partially automate the production of flight software. The Workbench will house a generic flight software domain architecture which will be tailorable to mission requirements. Guided by the tailored domai n architecture, the Workbench will assemble reUSAble software components to synthesize a mission flight application. This report provides an overview of the flight system domain analysis performed in support of the development of reUSAble flight software Eight diverse flight systems were surveyed and analyzed to identify common functional attributes requirements. The Shlaer-Mellor Object-Oriented Analysis methodology was used to guide the domain and the development of domain models. A generic flight system domain architecture was developed to the functional commonalities identified in the survey.

DTIC

Architecture (Computers); Applications Programs (Computers); Computer Programming; Flight Control; Mission Planning; ReUSAble Spacecraft

19960035853 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH USA

Validation of High Aspect Ratio Cooling in a 89 kN (20,000 lb(sub f)) Thrust Combustion Chamber

Wadel, Mary F., National Aeronautics and Space Administration. Lewis Research Center, USA; Meyer, Michael L., National Aeronautics and Space Administration. Lewis Research Center, USA; Jun. 1996; 16p; In English; 32nd; Joint Propulsion Conference, 1-3 Jul. 1996, Lake Buena Vista, FL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 242-20-06

Report No.(s): NASA-TM-107270; E-10337; NAS 1.15:107270; AIAA Paper 96-2584; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

In order to validate the benefits of high aspect ratio cooling channels in a large scale rocket combustion chamber, a high pressure, 89 kN (20,000 lbf) thrust, contoured combustion chamber was tested in the NASA Lewis Research Center Rocket Engine Test Facility. The combustion chamber was tested at chamber pressures from 5.5 to 11.0 MPa (800-1600 psia). The propellants were gaseous hydrogen and liquid oxygen at a nominal mixture ratio of six, and liquid hydrogen was used as the coolant. The combustion chamber was extensively instrumented with 30 backside skin thermocouples, 9 coolant channel rib thermocouples, and 10 coolant channel pressure taps. A total of 29 thermal cycles, each with one second of steady state combustion, were completed on the chamber. For 25 thermal cycles, the coolant mass flow rate was equal to the fuel mass flow rate. During the remaining four thermal cycles, the coolant mass flow rate was progressively reduced by 5, 6, 11, and 20 percent. Computer analysis agreed with coolant channel rib thermocouples within an average of 9 percent and with coolant channel pressure drops within an average of 20 percent. Hot-gas-side wall temperatures of the chamber showed up to 25 percent reduction, in the throat region, over that of a conventionally cooled combustion chamber. Reducing coolant mass flow yielded a reduction of up to 27 percent of the coolant pressure drop from that of a full flow case, while still maintaining up to a 13 percent reduction in a hot-gas-side wall temperature from that of a conventionally cooled combustion chamber.

Author

Rocket Engines; Combustion Chambers; Thrust Chambers; Mass Flow; Liquid Hydrogen; Cooling; High Aspect Ratio; Performance Tests

19960043057

Genetic algorithms applied to the aerodynamic design of transonic airfoils

Quagliarella, Domenico, Centro Italiano Ricerche Aerospaziali, Italy; Cioppa, Antonio Della; Journal of Aircraft; July 1995; ISSN 0021-8669; vol. 32, no. 4, pp. 889-891; In English; Copyright; Avail: Issuing Activity

The application of genetic algorithms to the design of shockless transonic airfoils is presented. Genetic algorithms offer an effective answer to complex optimization problems as they are able to effectively explore a very large space of potential solutions. The optimization procedure is tested both on a one-operating condition design problem and a two-operating condition one. The results show that the genetic algorithm developed is able to achieve satisfactory designs of shockless airfoils.

Author (EI)

Aerodynamic Coefficients; Aerodynamic Drag; Aerodynamics; Airfoils; Genetic Algorithms; Mach Number; Optimization; Pressure Ratio; Random Processes; Systems Analysis; Transonic Flow; Wave Drag

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.

19960040010

Computational study of large-disturbance oscillations in unsteady supersonic combustion around projectiles

Matsuo, Akiko, Inst of Space and Astronautical Science, Japan; Fujii, Kozo; AIAA Journal; October 1995; ISSN 0001-1452; vol. 33, no. 10, pp. 1828-1835; In English; Copyright; Avail: Issuing Activity

Unsteady combustion around a spherical projectile in supersonic flows is numerically studied using the simplified two-step chemical reaction model consisting of the induction and the exothermic reactions. A series of simulations indicates that the intensity of the concentration of the heat release is a key parameter to determine the regime of the unsteady flowfield. Flow features of the unsteady combustion with low-frequency and high-amplitude oscillation, which is called the large-disturbance regime, are reproduced when the concentration of the heat release of the chemical reaction is high. Mechanism of the large-disturbance regime is clarified based on the histories of the density and pressure profiles on the stagnation streamline and the flowfield in front of the projectile body. The period and amplitude of the oscillation corresponding to the shock pressure behind the bow shock agree with experimental observations, and the reproduction of the large-disturbance regime in the present simulation is confirmed.

Author (EI)

Combustion; Exothermic Reactions; Oscillations; Projectiles; Supersonic Combustion; Unsteady Flow

19960040011

Matrix dissipation for central difference schemes with combustion

Gerlinger, P., Univ of Stuttgart, Germany; Algermissen, J.; Brueggemann, D.; AIAA Journal; October 1995; ISSN 0001-1452; vol. 33, no. 10, pp. 1865-1870; In English; Copyright; Avail: Issuing Activity

The effect of artificial viscosity is investigated for problems related to supersonic combustion. An implicit lower-upper symmetric Gauss-Seidel finite volume method is employed for solving the full, compressible, two-dimensional averaged Navier-Stokes and species transport equations. For the right-hand side discretization central differences are used. Therefore some kind of artificial viscosity is necessary to reduce oscillations near shock waves and to enable convergence to machine accuracy. In comparison to the standard second- and fourth-order scalar dissipation a matrix dissipation reduces the amount of artificial viscosity by scaling each equation individually. For the necessary absolute flux Jacobian matrix a new decomposition is presented keeping the additional cost moderate. With an appropriate sensor the scheme also gets total variation diminishing properties. Calculations using different dissipation models are presented and advantages using a matrix dissipation are shown.

Author (EI)

Combustion; Difference Equations; Oscillations; Shock Waves; Supersonic Combustion; Supersonic Flow; Viscosity

19960043318

Structural response of counterflow diffusion flames to strain rate variations

Sung, C. J., Princeton Univ, USA; Liu, J. B.; Law, C. K.; Combustion and Flame; September 1995; ISSN 0010-2180; vol. 102, no. 4, pp. 481-492; In English; Copyright; Avail: Issuing Activity

The structural response of counterflowing methane/oxygen/nitrogen diffusion flames to aerodynamic straining was experimentally and computationally investigated. The temperature and major species concentration profiles were experimentally determined as functions of the applied strain rate by using spontaneous Raman scattering. The experimental situations were further computationally simulated with detailed reaction mechanisms and transport properties. The computed results were found to be in close quantitative agreement with the experimental data.

Author (EI)

Aerodynamics; Diffusion; Diffusion Flames; Flames; Heat Transfer; Methane; Nitrogen; Oxygen; Premixed Flames

19960044395 National Defense Academy, Japan
The Analysis of Initial Supersonic Combustion Process Using the NWT
Obata, Shigeo, National Defense Academy, Japan; Nagashima, Toshio, Tokyo Univ., Japan; Yamane, Takashi, National Aerospace Lab., Japan; Proceedings of the 13th NAL Symposium on Aircraft Computational Aerodynamics; Jan. 1996, pp. 59-64; In Japanese; Also announced as 19960044384; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The effects of active chemical species supplied from a plasma torch system upon initiating hydrogen combustion in a two-dimensional supersonic shear flow have been investigated by a molecular gas dynamic numerical approach. A direct simulation Monte Carlo (DSMC) method based on the Boltzmann equation has been employed with a reactive inelastic molecular collision model (IE model). Parametric study shows that hydrogen initial combustion can be significantly enhanced by the application of plasma supplying atomic oxygen in diffuse mode. And the DSMC method has some advantages for using parallel processing systems, so that the method of programming for the National Aerospace Laboratory Numerical Wind Tunnel (NWT) is introduced.
Author
Boltzmann Transport Equation; Computerized Simulation; Monte Carlo Method; Parallel Processing (Computers); Supersonic Combustion; Two Dimensional Flow; Shear Flow; Molecular Gases; Molecular Collisions; Combustion Efficiency

19960037110
Fatigue behaviour of mechanically fastened joints in composite materials
Lanciotti, A., Univ of Pisa, Italy; Lazzeri, L.; Raggi, M.; Composite Structures; 1995; ISSN 0263-8223; vol. 33, no. 2, pp. 87-94; In English; Copyright; Avail: Issuing Activity

This paper describes the results of a research activity, carried out at the Department of Aerospace Engineering at the University of Pisa in conjunction with AGUSTA, aimed at the characterisation of the fatigue behavior of composite joints. The activity was performed as a support to the certification of the tail of the new helicopter EH 101. Two types of specimens were defined taking the move from the design of the structure; they mainly differed in the thickness of the laminates, 2 and 4 mm, and were representative of critical areas. The specimens were impact damaged with an energy level capable of inducing a barely visible indentation, as required by the Certification Authority. Fatigue tests, under sinusoidal loading, R = 0.2, were carried out both in dry and wet conditions; the stiffness of the specimens was monitored during the fatigue tests. The comparison between the results obtained shows the considerable effect of impact damage and of humidity absorption on the fatigue resistance of composite joints.
Author (EI)
Aerospace Engineering; Composite Materials; Fatigue (Materials); Helicopters; Impact Damage; Research Facilities; Tail Assemblies

19960038297 Sandia National Labs., Albuquerque, NM USA
Compatibility of lead-free solders with lead containing surface finishes as a reliability issue in electronic assemblies
Vianco, Paul, Sandia National Labs., USA; Rejent, Jerry, Sandia National Labs., USA; Artaki, Iris, Bell Telephone Labs., Inc., USA; Ray, Urmi, Bell Telephone Labs., Inc., USA; Finley, Donald, Bell Telephone Labs., Inc., USA; Jackson, Anna, Bell Telephone Labs., Inc., USA; 1996; 16p; In English; IEEE Electronic Components and Technology Conference, 28 - 31 May 1996, Orlando, FL, USA
Contract(s)/Grant(s): DE-AC04-94AL-85000
Report No.(s): SAND-96-0455C; CONF-9605101-2; DE96-006464; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Enhanced performance goals and environmental restrictions have heightened the consideration for use of alternative solders as replacements for the traditional tin-lead (Sn-Pb) eutectic and near-eutectic alloys. However, the implementation of non-Pb bearing surface finishes may lag behind solder alloy development. A study was performed which examined the effect(s) of Pb contamination on the performance of Sn-Ag-Bi and Sn-Ag-Cu-Sb lead-free solders by the controlled addition of 63Sn-37Pb solder at levels of 0.5 (minus) 8.0 wt.%. Thermal analysis and ring-in-plug shear strength studies were conducted on bulk solder properties. Circuit board prototype studies centered on the performance of 20I/O SOIC gull wing joints. Both alloys exhibited declines in their melting temperatures with greater Sn-Pb additions. The ring-in-plug shear strength of the Sn-Ag-Cu-Sb solder increased slightly with Sn-Pb levels while the Sn-Ag-Bi alloy experienced a strength loss. The mechanical behavior of the SOIC (Small Outline Integrated Circuit) Sn-Ag-Bi solder joints reproduced the strength levels were insensitive to 10,106 thermal cycles. The Sn-Ag-Cu-Sb solder showed a slight decrease in the gull wing joint strengths that was sensitive to the Pb content of the surface finish.
DOE
Solders; Thermal Analysis; Mechanical Properties; Integrated Circuits; Eutectic Alloys; Surface Finishing; Wings

19960048964
Evaluation of fatigue and wear characteristics of M50 steel using high temperature synthetic turbine engine lubricants - Part II
Rosado, Lewis, USA Air Force, USA; Trivedi, Hitesh K.;

Gerardi, David T.; Wear; August 1996; ISSN 0043-1648; vol. 196, no. 1-2, pp. 133-140; In English; In English; Copyright; Avail: Issuing Activity

The fatigue and wear characteristics of AISI VIM-VAR M50 steel were evaluated using two high-temperature synthetic turbine engine lubricants. Rolling contact fatigue (RCF) tests were conducted on a ball-on-rod type rig at a cyclic Hertzian contact stress of 4.8 GPa (700 ksi) and temperatures of 177 C (350 F) and 274 C (525 F). The two lubricants tested included a five-ring polyphenylether (MIL-L-87100, 12.64 cSt at 100 C) and perfluoropolyalkylether (25.51 cSt at 100 C). RCF results were compared with those obtained with a polyolester (MIL-L-7808J) at 177 C. Weibull analysis and analysis of variance conducted on the RCF data show significant increases in fatigue life and reductions in wear rate when compared with MIL-L-7808J lubricant at 177 C. However, at 274 C, fatigue life was substantially reduced and wear of M50 steel increased with both high-temperature lubricants.
Author (EI)
Boundary Lubrication; Fatigue Tests; Lubricants; Lubrication; Physical Properties; Steels; Turbine Engines

19960035830 Arnold Engineering Development Center, Arnold AFS, TN USA
A Comparison of an AEDC and a Russian Developed Pressure Sensitive Paint in the AEDC Propulsion Wind Tunnel 16T ***Final Report, 23-28 Apr. 1995***
Sellers, M. E., Arnold Engineering Development Center, USA; Dec. 1995; 93p; In English
Report No.(s): AD-A302906; AEDC-TR-95-18; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A comparison of a pressure sensitive paint (PSP) developed at Arnold Engineering Development Center (AEDC) with a PSP developed in Russia was performed in the AEDC Propulsion Wind Tunnel 16T. A Generic Wall Interference Model similar to an old AEDC model used to study wall interference effects was fabricated at the Central Aerohydrodynamics Institute (TSAGI) in Zhukovsky, Russia. The model has been tested in TSAGI's T-128 wind tunnel, and was sent to AEDC with the balance and sting support hardware for the 16T test. The AEDC PSP and the Russian PSP were applied to separate wings of the model. Conventional pressure, PSP, and force data were acquired simultaneously at Mach numbers 0.60, 0.85, and 0.95 while angle of attack was varied from -10 to 10 deg. The stagnation pressure and temperature were also varied to permit evaluations of the pressure and temperature sensitivity of each paint. Comparisons of the conventional pressure and PSP measurements are presented.)
DTIC
Wind Tunnels; Angle of Attack; Aerodynamic Interference; Paints; Wall Flow; Wings; Stagnation Pressure

19960038266 Clemson Univ., South Carolina Energy Research and Development Center., SC USA
Functionally gradient materials for thermal barrier coatings in advanced gas turbine systems
Banovic, S.W., Lehigh Univ., USA; Chan, H. M., Lehigh Univ., USA; Barmak, K., Lehigh Univ., USA; Marder, A. R., Lehigh Univ., USA; Petronis, C. M., Lehigh Univ., USA; Puerta, D. G., Lehigh Univ., USA; Wu, S., Lehigh Univ., USA; Harmer, M. P., Lehigh Univ., USA; 1995; 11p; In English; Advanced Turbine Systems (ATS) Annual Program Review, 17-18 Oct. 1995, Morgantown, WV, USA; Sponsored by Department of Energy, USA
Contract(s)/Grant(s): DE-FC21-92MC-29061
Report No.(s): DOE/MC/29061-96/C0659; CONF- 9510109-30; DE96-008959; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

New designs for advanced gas turbine engines for power production are required to have higher operating temperatures in order to increase efficiency. However, elevated temperatures will increase the magnitude and severity of environmental degradation of critical turbine components (e.g. combustor parts, turbine blades, etc.). to offset this problem, the USAge of thermal barrier coatings (TBCs) has become popular by allowing an increase in maximum inlet temperatures for an operating engine. Although thermal barrier technology is over thirty years old, the principle failure mechanism is the spallation of the ceramic coating at or near the ceramic/bond coat interface. Therefore, it is desirable to develop a coating that combines the thermal barrier qualities of the ceramic layer and the corrosion protection by the metallic bond coat without the detrimental effects associated with the localization of the ceramic/metal interface to a single plane.
DOE
Gas Turbine Engines; Thermal Control Coatings; Turbine Blades; Functionally Gradient Materials; Combustion Chambers; Ceramic Coatings

19960038339 Oak Ridge National Lab., TN USA
High temperature mechanical performance of a hot isostatically pressed silicon nitride
Wereszczak, A. A., Oak Ridge National Lab., USA; Ferber, M. K., Oak Ridge National Lab., USA; Jenkins, M. G., Oak Ridge National Lab., USA; Lin, C. K. J., Oak Ridge National Lab., USA; Jan. 1996; 122p; In English
Contract(s)/Grant(s): DE-AC05-96OR-22464
Report No.(s): ORNL/TM-12943; DE96-010040; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Silicon nitride ceramics are an attractive material of choice for designers and manufacturers of advanced gas turbine engine components for many reasons. These materials typically have potentially high temperatures of usefulness (up to 1400 C), are chemically inert, have a relatively low specific gravity (important for inertial effects), and are good thermal conductors (i.e., resistant to thermal shock). In order for

manufacturers to take advantage of these inherent properties of silicon nitride, the high-temperature mechanical performance of the material must first be characterized. The mechanical response of silicon nitride to static, dynamic, and cyclic conditions at elevated temperatures, along with reliable and representative data, is critical information that gas turbine engine designers and manufacturers require for the confident insertion of silicon nitride components into gas turbine engines. This final report describes the high-temperature mechanical characterization and analyses that were conducted on a candidate structural silicon nitride ceramic. The high-temperature strength, static fatigue (creep rupture), and dynamic and cyclic fatigue performance were characterized. The efforts put forth were part of Work Breakdown Structure Subelement 3.2.1, 'Rotor Data Base Generation'. PY6 is comparable to other hot isostatically pressed (HIPed) silicon nitrides currently being considered for advanced gas turbine engine applications.
DOE
Gas Turbine Engines; Silicon Nitrides; Ceramics; High Temperature Tests; Creep Properties; Tensile Strength; Crack Propagation; Tensile Tests; Fatigue Tests; Hot Isostatic Pressing; Fatigue (Materials)

19960038382 Clemson Univ., South Carolina Energy Research and Development Center., SC USA
Bond strength and stress measurements in thermal barrier coatings
Gell, Maurice, Connecticut Univ., USA; Jordan, Eric, Connecticut Univ., USA; 1995; 17p; In English; Advanced Turbine Systems (ATS) Annual Program Review, 17-18 Oct. 1995, Morgantown, WV, USA; Sponsored by Department of Energy, USA
Contract(s)/Grant(s): DE-FC21-92MC-29061; 94-01-SR030
Report No.(s): DOE/MC/29061-96/C0676; CONF- 9510109-40; DE96-008950; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Thermal barrier coatings have been used extensively in aircraft gas turbines for more than 15 years to insulate combustors and turbine vanes from the hot gas stream. Plasma sprayed thermal barrier coatings (TBCs) provide metal temperature reductions as much as 300(degrees)F, with improvements in durability of two times or more being achieved. The introduction of TBCs deposited by electron beam physical vapor deposition (EB-PVD) processes in the last five years has provided a major improvement in durability and also enabled TBCs to be applied to turbine blades for improved engine performance. This program evaluates the bond strength of yttria stabilized zirconia coatings with MCrAlY and Pt-Al bond coats utilizing diffraction and fluorescence methods.
DOE
Thermal Control Coatings; Stress Measurement; Sprayed Coatings; Gas Turbine Engines; Combustion Chambers; Aircraft Engines

19960040674
Study on the composite screw rotors for superchargers
Kim, Young Goo, Korea Advanced Inst of Science and Technology, Taejon-shi, Korea, USA; Jeong, Kwang Seop; Lee, Dai Gil; Oh, Park Kyoun; Composite Structures; 1995; ISSN 0263-8223; vol. 32, no. 1-4, pp. 575-581; In English; Copyright; Avail: Issuing Activity

In this work, the screw rotors for superchargers were manufactured with chopped carbon fiber epoxy composite materials by resin transfer molding process. The manufactured composite screw rotors were tested in different combinations such as the male composite and female composite rotors, the male composite and female aluminum rotors, and the male aluminum and female composite rotors. The temperature and pressure increases of the air at the outlet and the required torque of the supercharger were measured with respect to the angular velocities.
Author (EI)
Carbon Fiber Reinforced Plastics; Carbon Fibers; Casting; Epoxy Resins; Manufacturing; Resin Transfer Molding; Rotors; Superchargers

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.

19960035321
Efficient representation of induced currents on large scatterers using the generalized pencil of function method
Altman, Zwi, Univ of Illinois at Urbana-Champaign, USA; Mittra, Raj; Hashimoto, Osamu; Michielssen, Eric; IEEE Transactions on Antennas and Propagation; January 1996; ISSN 0018-926X; vol. 44, no. 1, pp. 51-57; In English; Copyright; Avail: Issuing Activity

It is shown in this paper that the currents induced over large and smooth scatterers can often be represented by a series of complex exponentials with only a few terms. The generalized pencil of function method is employed to extract these exponentials from the numerical solution of the scattering problem derived by using the Method of Moments. Illustrative examples include a partially-coated two-dimensional scatterer modeling a helicopter blade and the three-dimensional problem of scattering by a thin plate. The ultimate objective of this effort is to solve a class of large-body scattering problems, for arbitrary angles of incidence including the grazing angle, by utilizing the numerically-derived, complex exponential type of basis functions extrapolated to higher frequencies. It is well known that the physical optics approximation for the induced current becomes inaccurate when the

angle of incidence is close to grazing, and the asymptotic methods, e.g., the GTD can become unwieldy for scatterers with edge treatments and those with complex geometrical shapes. The approach based upon the use of numerically derived entire domain basis functions on a portion of the body is proposed herein as a means to circumventing this difficulty.
Author (EI)
Electromagnetic Scattering; Mathematical Models; Method of Moments; Physical Optics; Rotary Wings

19960040121
Development of the airborne warning and control system (AWACS) radar
Cowdery, Robert E.; Skillman, William A.; IEEE Transactions on Aerospace and Electronic Systems; October 1995; ISSN 0018-9251; vol. 31, no. 4, pp. 1357-1365; In English; Copyright; Avail: Issuing Activity

The Airborne Warning and Control System (AWACS) radar was conceived out of the US Air Force's need for an airborne surveillance radar using pulse Doppler in a track-while-scan mode. The specific operational requirements included the achievement of excellent downlook detection and tracking performance. This led to the formulation of the Overland Radar Technology (ORT) Program to demonstrate that sufficient subclutter visibility could be obtained. Low sidelobe antenna technology was demonstrated and a high-power transmitter appeared feasible. Details of the development of the AWACS radar are presented.
Author (EI)
Aircraft Equipment; Clutter; Command and Control; Frequency Assignment; Radar Equipment; Visibility; Warning Systems

19960040249
Overlapping modal and geometric symmetries for computing jet-engine inlet scattering
Ross, Daniel C., Univ of Michigan, USA; Volakis, John L.; Anastassiu, Hristos T.; IEEE Transactions on Antennas and Propagation; October 1995; ISSN 0018-926X; vol. 43, no. 10, pp. 1159-1163; In English; Copyright; Avail: Issuing Activity

By examining the scattering from a cylindrical inlet terminated by a fan-like structure possessing discrete angular symmetry, it is found that only very limited intermodal coupling is possible. This fact is exploited in a hybrid finite element/modal scheme to develop a very efficient solution where only one slice of the geometry need be modeled. It is shown that a phase boundary condition at the interior walls of the mesh is sufficient for the complete solution of the problem. The implementation of the phase boundary condition is detailed for the full three-dimensional case, including special considerations for enforcing the boundary conditions along the axis. A simple example is shown for the sliced, hybrid finite element/modal scheme to validate the method.
Author (EI)
Applications of Mathematics; Electromagnetic Scattering; Engine Inlets; Geometry; Intake Systems; Jet Engines

19960046212
HAL-3 airborne navigation radar
ANON; IEEE Transactions on Aerospace and Electronic Systems; July 1996; ISSN 0018-9251; vol. 32, no. 3, pp. 1208-1211; In English; Copyright; Avail: Issuing Activity

This correspondence describes the HAL-3 navigation radar which was designed specially for civil airplanes. The main technical functions of the radar have been extensively tested on Boeing 707 and Y-7A airplanes to the military standard on aeronautic airborne facilities. The test results (left bracket) 1(right bracket) are qualified by the Chinese Appraisal Committee of Aeronautics Facilities. The technical specifications of the radar are similar to those of the RDR-1F radar manufactured in the U.S. with several added operational functions. The radar includes 7 units: antenna, transceiver, servo unit, control box, two display units and power supply. Operational principles and functions of each unit are described briefly. The current research project for interfacing the radar to a fiber-optic gyroscope is in process and some initial experimental results are described.
Author (EI)
Air Navigation; Aircraft Equipment; Navigation; Radar Antennas; Radar Equipment; Standards

19960046806
Efficient computation of radar scattering modulation from jet engines
Ross, Daniel C., Univ of Michigan, USA; Volakis, John L.; Anastassiu, Hristos T.; Radio Science; July 1996; ISSN 0048-6604; vol. 31, no. 4, pp. 991-997; In English; Copyright; Avail: Issuing Activity

By making use of the overlapping symmetries between the modal inlet fields and the engine face, it is found that the radar modulation due to a set of rotating blades can be computed using only one solution for any blade position. Frequency domain solutions for the stationary engine face can immediately produce modulation data with a simple postprocessing step. The validity of the modulation scheme is demonstrated with the aid of simplified engine model possessing a semianalytical mode-matching solution.
Author (EI)
Electromagnetic Scattering; Frequencies; Jet Engines; Modulation; Radar; S Matrix Theory

19960038250 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH USA
Variable-Speed Induction Motor Drives for Aircraft Environmental Control Compressors
Mildice, J. W., Motive Power Development, USA; Hansen, I. G., Motive Power Development, USA; Schreiner, K. E., Motive Power Development, USA; Roth, M. E., National Aero-

nautics and Space Administration. Lewis Research Center, USA; Jul. 1996; 8p; In English; 31st; Intersociety Energy Conversion Engineering Conference, 11-16 Aug. 1996, washington, DC, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Contract(s)/Grant(s): NAS3-27549; RTOP 244-02-02
Report No.(s): NASA-TM-107261; E-10325; NAS 1.15: 107261; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

New, more-efficient designs for aircraft jet engines are not capable of supplying the large quantities of bleed air necessary to provide pressurization and air conditioning for the environmental control systems (ECS) of the next generation of large passenger aircraft. System analysis and engineering have determined that electrically-driven ECS can help to maintain the improved fuel efficiencies; and electronic controllers and induction motors are now being developed in a NASA/NPD SBIR Program to drive both types of ECS compressors. Previous variable-speed induction motor/controller system developments and publications have primarily focused on field-oriented control, with large transient reserve power, for maximum acceleration and optimum response in actuator and robotics systems. The application area addressed herein is characterized by slowly-changing inputs and outputs, small reserve power capability for acceleration, and optimization for maximum efficiency. This paper therefore focuses on the differences between this case and the optimum response case, and shows the development of this new motor/controller approach. It starts with the creation of a new set of controller requirements. In response to those requirements, new control algorithms are being developed and implemented in an embedded computer, which is integrated into the motor controller closed loop. Buffered logic outputs are used to drive the power switches in a resonant-technology, power processor/motor-controller, at switching/resonant frequencies high enough to support efficient high-frequency induction motor operation at speeds up to 50,000-RPA
Author
Induction Motors; Power Converters; Environmental Control; Fuzzy Systems; Resonant Frequencies; Aircraft Compartments; Feedback Control

19960038960
Motor drive technologies for the Power-By-Wire (PBW) program: Options, trends and tradeoffs. Part I: Motors and controllers
Elbuluk, Malik E., Univ of Akron, USA; Kankam, M. David; IEEE Aerospace and Electronic Systems Magazine; November 1995; ISSN 0885-8985; vol. 10, no. 11, pp. 37-42; In English; Copyright; Avail: Issuing Activity

The Power-By-Wire (PBW) program involves the replacement of hydraulic and pneumatic systems currently used in aircraft with an all-electric secondary power system. One of the largest loads of the all-electric secondary power system will be the motor loads which include pumps, compressors and Electrical Actuators (EAs). Issues of improved reliability, reduced maintenance and efficiency, among other advantages, are the motivation for replacing the existing aircraft actuators with electrical actuators. The EA system contains the motor, the power electronic converters, the actuator and the control system, including the sensors. This paper and a companion paper give a comparative literature review in motor drive technologies, with a focus on the trends and tradeoffs involved in the selection of a particular motor drive technology. The reported research comprises the induction motor (IM), the brushless dc motor (BLDCM) and the switched reluctance motor (SRM) drive technologies. Each of the three drives has the potential for application in the PBW program. Many issues remain to be investigated and compared between the three motor drives, using actual mechanical loads expected in the PBW program.
Author (EI)
Actuators; Aircraft Equipment; Aircraft Parts; Control Equipment; Electric Motors; Electromechanical Devices; Mechanical Drives

19960046164
Hybridization of finite-element and high-frequency methods for pattern prediction for antennas on aircraft structures
Ozdemir, T., Univ of Michigan, USA; Nurnberger, M. W.; Volakis, J. L.; Kipp, R.; Berrie, J.; IEEE Antennas & Propagation Magazine; June 1996; ISSN 1045-9243; vol. 38, no. 3, pp. 28-38; In English; Copyright; Avail: Issuing Activity

This paper considers the hybridization of the finite-element and high-frequency methods for predicting the radiation pattern of printed antennas mounted on aircraft platforms. The finite-element method is used to model the cavity-backed antennas, whereas the interactions between the radiators and the substructures are treated via a high-frequency technique, such as the GTD, PO/PTD, or SBR. We present comparisons between measurements and calculations, along with a qualitative description of the finite-element and high-frequency codes employed.
Author (EI)
Aircraft Equipment; Antenna Radiation Patterns; Directional Antennas; Electrical Measurement; Finite Element Method; High Frequencies; Mathematical Models; Radar Equipment

19960046840
Electron transport in heavily doped bases of InP/GaInAs HBT's probed by magneto transport experiments
Betser, Yoram, Israel Inst of Technology, Israel; Ritter, Dan; IEEE Transactions on Electron Devices; August 1996; ISSN 0018-9383; vol. 43, no. 8, pp. 1187-1192; In English; Copyright; Avail: Issuing Activity

Magneto transport experiments were carried out to study electron transport in the p-type base of InP/GaInAs hetero-

junction bipolar transistors (HBT's). Electron minority carrier mobility was measured in the deg K for two dopant concentrations in the base. The experimentally obtained mobility is compared to the theoretically predicted one. The scattering mechanisms considered in the calculations are screened ionized impurity scattering, alloy scattering, and coupled plasmon polar optical phonon scattering. The latter is calculated in the random phase approximation. The Boltzman transport equation (BTE) is solved to obtain the ratio between the measured mobility and the drift mobility. Good agreement was obtained between the measured results and the calculated ones for temperatures above 100 deg K. At lower temperatures the calculated results differ from the experimental ones, probably due to hot electron effects.
Author (EI)
Bipolar Transistors; Electron Transfer; Gallium Compounds; Heterojunction Devices; Hot Electrons; Indium Phosphides; Semiconductors (Materials); Supersonic Commercial Air Transport

19960049126
Batteries vs. alternatives for storing energy
Oman, Henry; IEEE Aerospace and Electronic Systems Magazine; August 1996; ISSN 0885-8985; vol. 11, no. 8, pp. 37-43; In English; In English; Copyright; Avail: Issuing Activity

Electric utilities need quickly-available sources of power for supplying expected and unexpected peak loads. Among useful sources have been the energy stored in water by pumping it to elevated storage reservoirs, in air compressed into underground chambers, and in batteries. A new power source, tBase-load nuclear and coal-fired steam plants generate off-peak energy for recharging the depleted storage facility. The aero-derived gas turbine, challenges the economics of these traditional energy-storage means. These turbines have been designed for aircraft where quick startup, rapid change in output power, and high reliability are essential. With a 1426 C (2600 F) turbine inlet temperature the available efficiencies are 42% in simple-cycle operation and 60% in a combined-cycle power plant. A recent 84-MW natural-gas-burning peak-power plant cost $204 per kW. Pacific Gas and Electric's Helmes River pumped-hydro plant had cost $656 per kW. The combined-cycle gas turbine plants, with their low manpower requirements, are producing power that costs less than power from nuclear power plants. We examine the performance and economics available from these new power sources.
Author (EI)
Electric Batteries; Electric Energy Storage; Electric Power Plants; Electric Power Supplies; Gas Turbine Engines; Gas Turbines; Utilities

19960035440 Georgia Inst. of Tech., School of Aerospace Engineering., Atlanta, GA USA
Quasi-Periodicity In Vortex Flows *Final Report, Nov. 1992 - Sep. 1995*
Komerath, N. M., Georgia Inst. of Tech., USA; Hubner, J. P., Georgia Inst. of Tech., USA; Dixon, C. J., Georgia Inst. of Tech., USA; Oct. 13, 1995; 63p; In English
Contract(s)/Grant(s): F49620-93-1-0036; AF Proj. 2307
Report No.(s): AD-A303767; GITAER-EAD-95-7; AFOSR-TR-96-0013; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Part 1 summarizes the search for the origin and nature of nearly-periodic velocity fluctuations observed over fighters at incidence angles between 15 and 40 deg. The Strouhal number and spectral shape remain constant over a wide range of Reynolds number, but vary with incidence and sweep. A 1/32-scale F-15 and a 59.3-deg. cropped delta flat plate are used for detailed studies, but the phenomenon is general to leading-edge vortex flows. Empirical correlations are developed for various aircraft configurations and wing planforms. Cross-spectral analysis traced the fluctuations upstream along a helical path to the surface. Streaklines and laser velocimetry discovered spanwise counter-rotating structures in the surface shear region under the vortex, amplifying downstream. Remaining hypotheses are based on centrifugal instability and unsteady vortex-surface interaction. Surface mini-fences modified and attenuated the spectra by as much as 50%, reinforcing the finding of amplification from the surface layer. Part 2 details improvements to the High Angle of Attack Stability and Control code predicting swept-wing configuration aerodynamics. Effects of camber, edge bevels, and of multiple vortices on vortex loads and breakdown are accurately predicted, as well as the turbulent vortex core size.
DTIC
Vortices; Periodic Variations; Delta Wings; Flow Distribution; Shear Flow; Spectrum Analysis; Flow Visualization

19960036516
Active control of compressor stall inception: a bifurcation-theoretic approach
Liawa, Der-Cherng, Natl Chiao Tung Univ, USA; Abed, Eyad H.; Automatica; January 1996; ISSN 0005-1098; vol. 32, no. 1, pp. 109-115; In English; Copyright; Avail: Issuing Activity

Active control of the onset of stall instabilities in axial flow compression systems is pursued using bifurcation analysis of a dynamical model proposed by Moore and Greitzer. The state variables of this model are the mass flow rate, pressure rise, and the amplitude of the first-harmonic mode of the asymmetric component of the flow. A subcritical pitchfork bifurcation is found to occur at the inception of stall, resulting in a large-amplitude instability and associated hysteresis behavior. Using the throttle opening of the compression system for actuation, it is found that the eigenvalue that becomes zero at the onset of stall is linearly uncontrollable. This, along with uncertainty of the post-stall linearized model, motivates a consideration of nonlinear feedback control laws for mitigation of the jump and hysteresis behavior occurring at stall on-

set. Following the bifurcation control calculations introduced by Abed and Fu (left bracket) Abed, E. H. and J. H. Fu (1986). Local feedback stabilization and bifurcation control, I. Hopf bifurcation. Syst. Control Lett., 7, 11-17, and Abed, E. H. and J. H. Fu (1987). Local feedback stabilization and bifurcation control, II. Stationary bifurcation. Syst. Control Lett., 8, 467-473(right bracket), it is found that feedback incorporating a term quadratic in the first-harmonic flow asymmetry variable renders the pitchfork bifurcation supercritical. This introduces a new stable equilibrium near the nominal equilibrium after the nominal equilibrium itself has lost stability, thus eliminating the undesirable jump and hysteresis behavior of the uncontrolled system.
Author (EI)
Axial Flow; Branching (Mathematics); Compressors; Hysteresis; Mass Flow Rate; Mathematical Models; Pressure; Systems Stability

19960039922 Swedish National Testing and Research Inst., Boras, Sweden
State of the Art: Investigation of rotary air-to-air heat exchangers ***State of the Art: Undersoekning av ett stoerre antal installationer med roterande vaermevaxlare***
Carlsson, Thomas, Swedish National Testing and Research Inst., Sweden; Kovacs, P., Swedish National Testing and Research Inst., Sweden; Karlsson, Martin, Swedish National Testing and Research Inst., Sweden; Ruud, S., Swedish National Testing and Research Inst., Sweden; Fransson, J., Swedish National Testing and Research Inst., Sweden; Jun. 1995; ISSN 0284-5172; 66p; In Swedish
Report No.(s): SP-95-24; DE96-733865; ISBN 91-7848-553-3; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Pros and cons of rotary heat exchangers have been discussed during the last years in Sweden. The main problem has been the transfer of pollutants. In this study we have measured the amount of pollutants transferred by air and by sorption/desorption on the rotor. First we examined technical descriptions of 80 installed heat exchangers and then we made measurements on 17 of the air-to-air heat exchangers. Some of the main conclusions drawn are: The transfer of pollutants is in the range of 20% even if the installation is done properly. A hygroscopic material in the rotor causes an increased transfer of pollutants. The measurements show that 62% of the investigated systems had a pressure condition which causes leakage from the exhaust air to the supply air in spite of correctly installed fans. The report presents in detail the results and the analysis of measurements of pollutants in rotary air-to-air heat exchangers, and gives suggestions for reducing the transfer in existing heat exchangers.
DOE
Heat Exchangers; Sorption; Hygroscopicity; Rotors; Desorption; Contaminants; Air Pollution

19960040007 NASA Lewis Research Center, Cleveland, OH, USA
Advance in overset grid schemes: From Chimera to DRAGON grids
Kao, Kai-Hsiung, NASA Lewis Research Cent, USA; Liou, Meng-Sing, NASA Lewis Research Center, USA; AIAA Journal; October 1995; ISSN 0001-1452; vol. 33, no. 10, pp. 1809-1815; In English; Copyright; Avail: Issuing Activity

A new approach that uses nonstructured mesh to replace the arbitrarily overlapped structured regions of embedded grids is presented. The present methodology uses the Chimera overlapped structured grids that are independently generated and body fitted, yielding a high-quality grid readily accessible for efficient solution schemes. A hybrid grid scheme is then proposed that maximizes the advantages of the Chimera scheme and adapts the strengths of the unstructured grid while at the same time keeps its weaknesses minimal. This new adaptation to the Chimera thinking is the direct replacement of arbitrary grid overlapping by nonstructured (DRAGON) grid. The nonstructured grid region sandwiched between the structured grids is limited in size, resulting in only a small increase in memory and computational effort. The DRAGON grid method has three important advantages: 1) preserving strengths of the Chimera grid, 2) eliminating difficulties sometimes encountered in the Chimera scheme, and 3) making grid communication in a fully conservative and consistent manner insofar as the governing equations are concerned. Numerical results on representative two-dimensional steady and unsteady inviscid flows are demonstrated.
Author (EI)
Aerodynamics; Computational Fluid Dynamics; Computational Grids; Unsteady Flow

19960040009
Multigrid acceleration of an upwind Euler solver on unstructured meshes
Ollivier-Gooch, Carl F., Natl Research Council, USA; AIAA Journal; October 1995; ISSN 0001-1452; vol. 33, no. 10, pp. 1822-1827; In English; Copyright; Avail: Issuing Activity

Multigrid acceleration has been implemented for an upwind flow solver on unstructured meshes. The flow solver is a straightforward implementation of Barth and Jespersen's unstructured scheme, with least-squares linear reconstruction and a directional implementation of Venkatakrishnan's limiter. The multigrid scheme itself is designed to work on mesh systems that are not nested, allowing great flexibility in generating coarse meshes and in adapting fine meshes. A new scheme for automatically generating coarse unstructured meshes from fine ones is presented. A subset of the fine mesh vertices is selected for retention in the coarse mesh. The coarse mesh is generated incrementally from the fine mesh by removing one rejected vertex at a time. In this way, a valid coarse mesh triangulation is guaranteed. Factors affecting multigrid convergence rate for inviscid flow are thoroughly

examined, including the effect of the number of coarse meshes used, the type of multigrid cycle employed, the spatial discretization used on coarse meshes, and the nature of the flow. The present multigrid scheme is very successful in reducing computational time for inviscid flows in the subsonic and transonic regime.
Author (EI)
Acceleration (Physics); Aerodynamics; Computational Fluid Dynamics; Mathematical Models

19960042336
Evaluating the temporal accuracy of inlet normal shock propagation simulations
Paynter, Gerald C., Boeing Commercial Airplane Group, USA; Mayer, David W.; AIAA Journal; August 1995; ISSN 0001-1452; vol. 33, no. 8, pp. 1534-1536; In English; Copyright; Avail: Issuing Activity

The NPARC flow simulation software is being used to evaluate the unstart properties of a variety of inlet concepts, to support wind-tunnel tests aimed at evaluating inlet stability, and to support design of the inlet control system. Development of appropriate boundary conditions for unsteady Euler/Navier-Stokes inlet flow simulations has been under way for some time. Now that appropriate boundary conditions are available for these simulations, this paper considers the numerical time accuracy of the code for these tasks.
Author (EI)
Civil Aviation; Computational Fluid Dynamics; Computerized Simulation; Intake Systems; Pressure; Shock Waves; Standing Waves; Supersonic Transports; Time Dependence; Unsteady Flow

19960044387 Nippon Electric Co. Ltd., Fundamental Research Labs., Tokyo, Japan
Numerical MPP Simulation on Compressible Fluid
Ohnishi, Shohei, Nippon Electric Co. Ltd., Japan; Kanazawa, Eiju, Nippon Electric Co. Ltd., Japan; Wada, Yasuhiro, National Aerospace Lab., Japan; Ogawa, Satoru, National Aerospace Lab., Japan; Fukuda, Masahiro, National Aerospace Lab., Japan; Proceedings of the 13th NAL Symposium on Aircraft Computational Aerodynamics; Jan. 1996, pp. 13-16; In Japanese; Also announced as 19960044384; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Computational fluid dynamics (CFD) has an increasingly important role in the design and development of aeronautical and space vehicles. It is well known that the costs of the design of aerospace vehicles can be greatly reduced by using the CFD technique. A recent trend in CFD is computation around more complex and realistic configurations. Considering the limitation of the cost performance of a single processor shared memory machine, progress is being made in the direction of the application of massively parallel processor (MPP) architectures. In this presentation, we introduce the CFD calculation using the message passing interface (MPI) in the National Aerospace Laboratory (NAL) MPP system, Intel paragon XP/S25(336 nodes). Discussions are focused on the multiple instruction of multiple data (MIMD) type treatment for the total variation diminishing (TVD) scheme code of two dimensional Euler equations. The numerical higher order scheme is the 5 points difference one. The numerical simulation of shock diffraction around a 90 degree corner is performed. The numerical region is divided into regular small regions which correspond to the MPP nodes; each node takes care of local numerical calculations with different boundary conditions. In the present situation, the local region is categorized into 9 types. Any small region belongs to one of them. Boundary values with two additional meshes are transferred to each other using MPI in different configurations. Moving wave fronts are visualized by applying the MPI in the standard MIMD treatment. The efficiency in relation to space complexity will be discussed by changing the mesh size and number of nodes.
Author
Parallel Processing (Computers); MIMD (Computers); TVD Schemes; Boundary Conditions; Compressible Fluids; Aircraft Design; Computer Aided Design; Massively Parallel Processors; Euler Equations of Motion; Differential Equations

19960044393 National Aerospace Lab., Tokyo, Japan
Navier-Stokes Simulation for a Complete Aircraft Configuration
Takanashi, Susumu, National Aerospace Lab., Japan; Ito, Ryozo, Daiko Denshi Tsushin Ltd., Japan; Amano, Kanichi, Japan Aircraft Development Corp., Japan; Kaiden, Takeshi, Mitsubishi Heavy Industries Ltd., Japan; Proceedings of the 13th NAL Symposium on Aircraft Computational Aerodynamics; Jan. 1996, pp. 47-52; In Japanese; Also announced as 19960044384; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A three dimensional (3D) Navier-Stokes simulation of a complete aircraft configuration has been carried out using the parallel vector computer called 'NWT' (numerical wind tunnel) at the National Aerospace laboratory, Japan. The governing equations are 3D Reynolds-averaged thin layer Navier-Stokes equations which are discretized by finite volume method with a total variation diminishing (TVD) upwind scheme. The multi-domain structured grid around the complete aircraft configuration has been generated by the point-charge distribution model.
Author
TVD Schemes; Computational Fluid Dynamics; Finite Volume Method; Navier-Stokes Equation; Structured Grids (Mathematics); Three Dimensional Models; Aircraft Configurations; Aerodynamic Configurations; Computerized Simulation; Upwind Schemes (Mathematics)

19960044401 National Aerospace Lab., Tokyo, Japan
An Unsteady Simulation of Impeller and Diffuser in a Centrifugal Compressor
Yamane, Takashi, National Aerospace Lab., Japan; Proceedings of the 13th NAL Symposium on Aircraft Computational Aerodynamics; Jan. 1996, pp. 93-98; In Japanese; Also announced as 19960044384; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An unsteady Navier-Stokes solver for cascade flow problems, which was developed on the Numerical Wind Tunnel (NWT) system has been modified for a more rapid calculation speed. The new code uses multiple processor groups for multiple calculation regions and thus a 70 times faster speed was obtained by 120 PE's consisting of five 24-PE groups.
Author
Cascade Flow; Centrifugal Compressors; Impellers; Navier-Stokes Equation; Computerized Simulation; Parallel Processing (Computers); Computer Programming; Diffusers

19960044421 National Aerospace Lab., Tokyo, Japan
Comparison Between Computation and Experiment of Aerodynamic Heating on a Sphere in Hypersonic Flow
Wang, Jian-Ping, National Aerospace Lab., Japan; Hamamoto, Shigeru, National Aerospace Lab., Japan; Yamamoto, Yukimitsu, National Aerospace Lab., Japan; Inoue, Yasutoshi, National Aerospace Lab., Japan; Proceedings of the 13th NAL Symposium on Aircraft Computational Aerodynamics; Jan. 1996, pp. 211-216; In Japanese; Also announced as 19960044384; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A computational fluid dynamic (CFD) code for a spectral method of compressible Navier-Stokes equations for the calculation of hypersonic flow around a hemisphere has been developed. An experiment of aerodynamic heating on a series of hemispheres with different diameters was also accomplished. In this paper, we compare the results between the CFD code, the experiment and the theories, showing that good agreement is obtained.
Author
Computational Fluid Dynamics; Hypersonic Flow; Navier-Stokes Equation; Aerodynamic Heating; Hemispherical Shells; Temperature Measurement; Density Measurement; Pressure Measurement

19960044671 Clemson Univ., Dept. of Mechanical Engineering., SC USA
Equipment for Enhancing and Extending Fluid Mechanics and Heat Transfer Research in Aeroengines *Final Report, Sep. 1993 - Sep. 1995*
Wang, Ting, Clemson Univ., USA; Pinson, Mark, Clemson Univ., USA; Dec. 12, 1995; 37p; In English
Contract(s)/Grant(s): F49620-93-1-0533
Report No.(s): AD-A304723; AFOSR-TR-96-0014; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The DoD Grant (No. F4962O-93-1) has been used to significantly expand and upgrade the capabilities of the facilities and instrumentation used by projects supported by AFOSR Grant No. F49620-94-0126 and by DoD EPSCoR fellowship grant No. F49620-92-J-0459. These two projects focus on experimental studies for flow and thermal structures in the hot flow passage in gas turbines. A summary of the expenditures has been included. Some changes were made from the original budget, and the details of these changes have been provided. Several custom-manufactured probes were specifically designed for measuring heat transfer and fluid flow structures within transitional boundary layers. The preliminary results were able to resolve the controversial issue regarding the negative value of cross-stream Reynolds beat flux (vt) in a transitional boundary layer. The expanded capability of the instrumentation also benefited research on the Advanced Turbine Systems project sponsored by the Department of Energy and on heat transfer enhancement using micro-structured surfaces sponsored by the 3M Company.
DTIC
Fluid Mechanics; Heat Transfer; Aircraft Engines; Gas Turbine Engines; Measuring Instruments; Test Chambers; Reynolds Stress; Heat Flux

19960046842
Large-eddy simulation of a plane jet in a cross-flow
Jones, W. P., Imperial Coll of Science, UK; Wille, M.; InterNational Journal of Heat and Fluid Flow; June 1996; ISSN 0142-727X; vol. 17, no. 3, pp. 296-306; In English; Copyright; Avail: Issuing Activity

A plane jet in a cross-flow has been simulated using large-eddy simulation (LES) with artificial inflow and wall boundary conditions. A mesh adapted on the mean velocity field was used to increase the resolution in the jet shear layer. Results from simulations with a standard Smagorinsky-Lilly model, a one-equation model, and a dynamic model are compared. Agreement between the measured and predicted results is reasonable overall, but difference between simulations with the various residual scale models are small.
Author (EI)
Boundary Conditions; Computerized Simulation; Cross Flow; Fluid Mechanics; Jet Aircraft

19960046843
Turbulence modeling of rotating confined flows
Elena, Laurent, Inst de Recherche sur les Phenomenes Hors d'Equilibre, France; Schiestel, Roland; InterNational Journal of Heat and Fluid Flow; June 1996; ISSN 0142-727X; vol. 17, no. 3, pp. 283-289; In English; Copyright; Avail: Issuing Activity

We propose here an original differential stress model which takes into account some of the implicit effects of rotation on the turbulence. It is applied to the numerical prediction of the turbulent flow inside a shrouded rotor-stator system.

The results of this model are compared to those obtained with four other turbulence models and to the experimental data. The advanced second-order models produce quite correct predictions for the mean flow, but it is shown that it is necessary to take account of the rotation effects in order to obtain satisfactory behavior of the Reynolds stress.
Author (EI)
Fluid Mechanics; Mathematical Models; Reynolds Stress; Rotation; Rotors; Stress Analysis; Turbulent Flow

19960046844
Aerodynamic analysis of turbine cascade by using a second-order closure of turbulence
Amano, R. S., Univ of Wisconsin-Milwaukee, USA; Rieger, N. F.; Hesler, S.; InterNational Journal of Heat and Fluid Flow; June 1996; ISSN 0142-727X; vol. 17, no. 3, pp. 278-282; In English; Copyright; Avail: Issuing Activity

Numerical predictions of cascade flows within an axial turbine stage are analyzed in this paper. A second-order Reynolds stress turbulence closure model was employed, which was formulated using the body-fitted curvilinear coordinates. The fractional step method of a finite difference scheme was employed for the numerical computations. The computations of the pressure, heat transfer, and turbulence stresses are presented in both stator and rotor flow regions. Comparisons are made between the Reynolds stress model and the k - epsilon model and demonstrated the superiority of the Reynolds stress model.
Author (EI)
Aerodynamics; Axial Flow; Fluid Mechanics; Mathematical Models; Reynolds Stress; Spherical Coordinates; Stresses; Turbomachinery; Turbulence

19960049365
Computational fluid-structure interaction model for parachute inflation
Benney, Richard John, U.S. Army Natick Research, Development, and Engineering Cent, Natick, USA; Stein, Keith Robert; Journal of Aircraft; July 1996; ISSN 0021-8669; vol. 33, no. 4, pp. 730-736; In English; In English; Copyright; Avail: Issuing Activity

In parachute research, the canopy inflation process is the least understood and the most complex to model. Unfortunately it is during the opening process that the canopy often experiences the largest deformations and loadings. The complexity of modeling the opening process stems from the coupling between the structural dynamics of the canopy, lines, and payload with the aerodynamics of the surrounding fluid medium. The addition of a computational capability to model the coupled opening behavior would greatly assist in the understanding of the canopy inflation process. This article describes research that involves coupling a computational fluid dynamics code to a mass spring damper parachute structural code. The axisymmetric codes are coupled with an explicit marching method. The current model is described and results for a round parachute are presented. A comparison of the numerical results to experimental data will be presented. The successful solution of these problems gives us confidence that the computational aeroelastic problem for parachute openings can be solved. This solution allows moving the parachute design process from one of cut and try to one based on experimentally verified computational tools and reduces the reliance on costly and time-consuming testing during development.
Author (EI)
Computation; Computational Fluid Dynamics; Computerized Simulation; Hydrodynamics; Parachutes

19960037550
Examination of the flow around a hot-wire probe using particle image velocimetry
Graham, L. J. W., CSIRO, Australia; Soria, J.; Bremhorst, K.; Experiments in Fluids; October 1995; ISSN 0723-4864; vol. 19, no. 6, pp. 379-382; In English; Copyright; Avail: Issuing Activity

Previous work has shown that the k(sup 2) term in the effective cooling velocity equation for inclined hot-wires can become negative under certain probe configurations and wire length-to-diameter ratios. It was hypothesised that this was due to a downwash component of velocity along the wire when prong interference effects were expected to be minimal. Direct measurements of the flow around a typical hot-wire probe using digital particle image velocimetry have shown that this downwash velocity component does exist, leading to negative values of k(sup 2) as calculated from the angle of deviation from the free stream.
Author (EI)
Aerodynamic Interference; Aerodynamics; Flow Measurement; Fluid Mechanics; Particle Image Velocimetry; Velocity Measurement

19960039030
Levitation of a micromachined rotor for application in a rotating gyroscope
Shearwood, C., Univ of Sheffield, UK; Williams, C. B.; Mellor, P. H.; Yates, R. B.; Gibbs, M. R. J.; Mattingley, A. D.; Electronics Letters; October 12 1995; ISSN 0013-5194; vol. 31, no. 21, pp. 1845-1846; In English; Copyright; Avail: Issuing Activity

The design of a micromachined rotating gyroscope is described, incorporating an electromagnetically levitated aluminum rotor. The coil design for levitation produces good lateral stability. A 400 micron diameter, 12 micron thick rotor is levitated to a height of 30 micron.
Author (EI)
Aluminum; Electric Coils; Electric Fields; Gyroscopes; Magnetic Induction; Magnetic Suspension; Rotors

19960040949 Naval Research Lab., Bay Saint Louis, MS USA

Warfighting Contributions of the Geosat Follow-On Altimeter *Final Report*

Jacobs, Gregg A., Naval Research Lab., USA; Carnes, Michael R., Naval Research Lab., USA; Fox, Daniel N., Naval Research Lab., USA; Hurlburt, Harley E., Naval Research Lab., USA; Rhodes, Robert C., Naval Research Lab., USA; Teague, William J., Naval Research Lab., USA; Blaha, John P., Naval Research Lab., USA; Crout, Richard, Naval Research Lab., USA; Smedstad, Ole Martin, Planning Systems, Inc., USA; Feb. 09, 1996; 16p; In English; Original contains color plates

Report No.(s): AD-A304889; NRL/MR/7323--96-7722; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Geosat Follow On altimeter will provide valuable information to the warfighter on-scene. This real time knowledge of the ocean environment is critical to making intelligent decisions in the field. In particular, the acoustic environment depends on the synoptic mesoscale density distribution which is retrievable from the altimeter. Surface geostrophic currents are inferred from the altimeter data, and these allow calculation of mine drift paths. Altimeter data also provides key data for forecasting tidally generated heights and currents throughout the world. For numerical ocean models, it represents the most useful source of operational oceanic data for nowcasting and forecasting of ocean frontal locations, meandering currents and mesoscale eddies as well as larger scale oceanic analysis.

DTIC

Altimeters; Geosat Satellites; Height; Ocean Models; Ocean Currents; Air Currents; Real Time Operation; Nowcasting

19960042183

Minimum-time reorientation of a two-degree-of-freedom gyroscope

Boyarski, Shmuel, Tel-Aviv Univ, Israel; Ben-Asher, Joseph Z.; Journal of Guidance, Control, and Dynamics; July 1995; ISSN 0731-5090; vol. 18, no. 4, pp. 782-791; In English; Copyright; Avail: Issuing Activity

The problem of time-optimal reorientation of the inner gimbal of a two-degree-of-freedom gimballed gyroscope mounted on a nonrotating base is considered. The states in the gyro model are the gimbal's angles (nutation is ignored). The model is nonlinear (not limited to small angles), state constrained, control limited, and double input, double output. A simple, explicit solution based on an intuitive observation is presented; it exploits the system's nonlinearity and channel coupling for attaining the minimum-time goal. It is analytically shown, in detail, that the solution satisfies the Maximum Principle and fulfills a sufficient condition for optimality based on the Hamilton-Jacobi-Bellman equation.

Author (EI)

Control Moment Gyroscopes; Gyroscopes; Rotors; Sensors; Spacecraft

19960046048

Application of a numerical procedure for the dynamic analysis of plane aeronautical structures

Tizzi, S., Univ of Rome 'La Sapienza', Italy; Journal of Sound and Vibration; June 27 1996; ISSN 0022-460X; vol. 193, no. 5, pp. 957-983; In English; Copyright; Avail: Issuing Activity

The main purpose of this paper concerns the applicability of a particular numerical procedure that is an alternative to the finite element method (F.E.M.) for a simplified dynamic analysis of plane aeronautical structures. Cantilever rectangular or trapezoidal plates with constant or variable thickness have been considered in the modelling. These elements are representative of typical aeronautical structural components such as wing or tail surface structures, which might also be formed by two or more parts having the above-mentioned geometry. Since there is the possibility of the occurrence of shear strain, according to Mindlin plate theory, transverse deformability has been taken into account. A study of the coupling phenomenon between the flexural-torsional and shear vibration modes has also been included.

Author (EI)

Aircraft Equipment; Aircraft Parts; Computerized Simulation; Dynamic Response; Numerical Analysis; Plate Theory; Plates (Structural Members); Structural Analysis; Tail Surfaces

19960046068

Dynamic characterization of temperature sensors by laser excitation

Castellini, P., Univ of Ancona, Italy; Rossi, G. L.; Review of Scientific Instruments; July 1996; ISSN 0034-6748; vol. 67, no. 7, pp. 2595-2601; In English; Copyright; Avail: Issuing Activity

Reported here is the development of a dynamic calibration technique for use in sensors that measure flow temperature. The experimental technique allows in situ applications, and is able to independently determine both the time constant of the sensor and the value of the convective heat exchange coefficient.

Author (EI)

Air Flow; Argon Lasers; Convective Heat Transfer; Laser Ablation; Mathematical Models; Resistance Thermometers; Sensors; Temperature Measurement; Temperature Sensors; Wind Tunnels

19960034692

Use of dFRFs for diagnosis of asymmetric/anisotropic properties in rotor-bearing system

Joh, Chee-Young, Agency for Defense Development, USA; Lee, Chong-Won; Journal of Vibration and Acoustics, Transactions of the ASME; January 1996; ISSN 1048-9002; vol.

118, no. 1, pp. 64-69; In English; Copyright; Avail: Issuing Activity

The diagnostic method, which utilizes the dFRFs defined in the stationary and rotating coordinate systems, is tested with a laboratory flexible rotor-bearing system, in order to verify its effectiveness in detection of the asymmetry in shaft and the anisotropy in stator. The experimental results indicate that the dFRFs can be effectively used for the diagnosis of anisotropy and/or asymmetry in rotor systems by the investigation of two kinds of dFRF estimates using the complex input and output signals defined in the stationary and rotating coordinate systems.

Author (EI)

Anisotropy; Frequency Response; Rotors; Shafts (Machine Elements)

19960035852 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH USA

Experimental Study of Split-Path Transmission Load Sharing

Krantz, Timothy L., Army Research Lab., USA; Delgado, Irebert R., Army Research Lab., USA; Jun. 1996; 14p; In English; 7th; InterNational Power Transmission and Gearing Conference, 6-9 Oct. 1996, San Diego, CA, USA; Sponsored by American Society of Mechanical Engineers, USA

Contract(s)/Grant(s): RTOP 505-62-36; DA Proj. 1L1-62211-A-47-A

Report No.(s): NASA-TM-107202; E-10187; NAS 1.15:107202; ARL-TR-1067; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Split-path transmissions are promising, attractive alternatives to the common planetary transmissions for helicopters. The split-path design offers two parallel paths for transmitting torque from the engine to the rotor. Ideally, the transmitted torque is shared equally between the two load paths; however, because of manufacturing tolerances, the design must be sized to allow for other than equal load sharing. to study the effect of tolerances, experiments were conducted using the NASA split-path test gearbox. Two gearboxes, nominally identical except for manufacturing tolerances, were tested. The clocking angle was considered to be a design parameter and used to adjust the load sharing of an otherwise fixed design. The torque carried in each path was measured for a matrix of input torques and clocking angles. The data were used to determine the optimal value and a tolerance for the clocking angles such that the most heavily loaded split path carried no greater than 53 percent of an input shaft torque of 367 N-m. The range of clocking angles satisfying this condition was -0.0012 +/- 0.0007 rad for box 1 and -0.0023 +/- 0.0009 rad for box 2. This study indicates that split-path gearboxes can be used successfully in rotorcraft and can be manufactured with existing technology.

Author

Helicopters; Gears; Torque; Transmissions (Machine Elements)

19960037710

Coupled torsional-flexural vibration of shaft systems in mechanical engineering - I. Finite element model

Qing, Hua Qin, Huazhong Univ, China; Cheng, Xiong Mao; Computers and Structures; February 17 1996; ISSN 0045-7949; vol. 58, no. 4, pp. 835-843; In English; Copyright; Avail: Issuing Activity

A new shaft element model with 10 degrees of freedom for coupled torsional-flexural vibration of rotor systems is developed. The model is based on an extended Hamilton's principle and includes the effects of translational and rotational inertia, gyroscopic moments, bending, shear and torsional deformations, internal viscous and hysteretic damping, and mass eccentricity. The practical efficiency of the new element has been assessed through a series of examples.

Author (EI)

Deformation; Degrees of Freedom; Finite Element Method; Mathematical Models; Rotors; Shafts (Machine Elements); Vibration

19960038775

Laminar flow rotor for a radial inflow turbine

Huntsman, I., Univ of Canterbury, New Zealand; Hodson, H. P.; Journal of Propulsion and Power; November 1995; ISSN 0748-4658; vol. 11, no. 6, pp. 1170-1178; In English; Copyright; Avail: Issuing Activity

The state of the boundary layers on the blade surfaces of the rotor of a radial turbine has been investigated using surface-mounted hot-film anemometers. The boundary layers are shown to be laminar or intermittently turbulent at the design flow condition. This is despite the fact that the Reynolds number is relatively high and conventional two-dimensional numerical techniques predict transition at about 20% surface length. The boundary layer does not become fully turbulent because there is strong secondary flow and large acceleration of the flow close to the surface. Surface pressure distributions and an inviscid prediction method are used to assist in the explanation for the state of the boundary layers.

Author (EI)

Boundary Layers; Inviscid Flow; Laminar Flow; Prediction Analysis Techniques; Pressure Distribution; Radial Flow; Rotors; Turbines; Turbomachine Blades; Turbomachinery

19960038776 NASA Lewis Research Center, Cleveland, OH, USA

Three-dimensional Navier-Stokes heat transfer predictions for turbine blade rows

Boyle, R. J., NASA Lewis Research Cent, USA; Giel, P. W., NASA Lewis Research Center, USA; Journal of Propulsion and Power; November 1995; ISSN 0748-4658; vol. 11, no. 6, pp. 1179-1186; In English; Copyright; Avail: Issuing Activity

Results are shown for a three-dimensional Navier-Stokes analysis of both the flow and the surface heat transfer for four turbine blade rows. Heat transfer comparisons are made with the experimental shock-tunnel data of Dunn and Kim and with the data of Blair for the rotor of a large-scale rotating turbine. The analysis was done using the steady-state, three-dimensional, thin-layer Navier-Stokes code developed by Chima, which uses a multistage Runge-Kutta scheme with implicit residual smoothing. An algebraic mixing length turbulence model is used to calculate turbulent eddy viscosity. The variation in heat transfer due to variations in grid parameters is examined. The effects of rotation, tip clearance, and inlet boundary-layer thickness variation on the predicted blade and end-wall heat transfer are examined.
Author (EI)
Eddy Viscosity; Fluid Flow; Heat Transfer; Navier-Stokes Equation; Rotors; Shock Tunnels; Stanton Number; Turbomachine Blades; Turbulence

19960038777
Simplified approach for control of rotating stall Part 1: theoretical development
Badmus, O. O., Georgia Inst of Technology, USA; Chowdhury, S.; Eveker, K. M.; Nett, C. N.; Rivera, C. J.; Journal of Propulsion and Power; November 1995; ISSN 0748-4658; vol. 11, no. 6, pp. 1195-1209; In English; Copyright; Avail: Issuing Activity

In this article the theoretical foundations of a simplified approach for control of rotating stall are presented. This approach requires two-dimensional sensing, but only a single one-dimensional axisymmetric effector with relatively low bandwidth requirements. The reduced actuation requirements of this approach are a consequence of the fact that in this approach one does not require or act upon rotating stall phase information. This is due to the fact that one does not seek to extend the theoretical stable axisymmetric flow range of the compressor. Rather, one seeks to directly address persistent disturbances that would otherwise throttle the equilibrium into the unstable axisymmetric flow range of the compressor. In addition, one seeks to enlarge the domains of attraction of linearly stable axisymmetric equilibria, thereby addressing impulsive disturbances that would otherwise perturb the system state beyond the domain of attraction of the stable axisymmetric equilibrium. Experimental validation of this approach on a single-stage low-speed axial compressor rig is discussed in Part 2 of this article.
Author (EI)
Axisymmetric Flow; Compressors; Control Equipment; Damping; Oscillations; Rotating Stalls

19960038778
Simplified approach for control of rotating stall Part 2: experimental results
Badmus, O. O., Georgia Inst of Technology, USA; Chowdhury, S.; Eveker, K. M.; Nett, C. N.; Rivera, C. J.; Journal of Propulsion and Power; November 1995; ISSN 0748-4658; vol. 11, no. 6, pp. 1210-1223; In English; Copyright; Avail: Issuing Activity

The primary objective of this article is to provide experimental validation of the simplified approach to control of rotating stall presented in Part 1 of this article. The experimental rig utilized is a low-speed, single-stage axial compressor rig. It is shown that the controller based on this approach has significant ability to reject persistent disturbances that cause the uncontrolled system to enter rotating stall. In addition, it is shown that the effective stable axisymmetric flow range of the compressor has been extended by this controller. This is a consequence of the fact that the controller enlarges the domains of attraction of linearly stable axisymmetric equilibria. A secondary objective of this article is the investigation of the presence of rotating stall precursors in this rig. Our motivation here is to determine the most appropriate signal processing to apply to sensor data prior to using it in the controller. In this rig, two first-mode rotating stall precursors traveling at different speeds are found when appropriate spectral separation of measured data is performed.
Author (EI)
Axisymmetric Flow; Compressors; Damping; Fluid Flow; Oscillations; Rotating Stalls; Signal Processing

19960038786
Active vibration control of a flexible rotor
Abduljabbar, Z., King Saud Univ, Saudi Arabia; Elmadany, M. M.; Alabdulwahab, A. A.; Computers and Structures; Feb ruary 3 1996; ISSN 0045-7949; vol. 58, no. 3, pp. 499-511; In English; Copyright; Avail: Issuing Activity

In this work, a finite element model of a multibearing rotor system is presented. The effects of rotary inertia, gyroscopic moments, internal viscous and hysteretic damping and shear deformations have been included. The characteristics of the fluid-film bearings are represented by eight stiffness and damping coefficients which are functions of Sommerfeld number. An optimal controller has been derived based on characteristics peculiar to rotor bearing systems which take into account the requirements for the free vibration and the persistent unbalance excitations. The controller uses as feedback signals, the states and the unbalance forces. A methodology of selecting the gains on the feedback signals has been presented based on separation of the signal effects: the plant states are the primary stimulates for stabilizing the rotor motion and augmenting system damping, while the augmented states representing the unbalanced forces are the primary stimulus for counteracting the periodically excited vibration. The results demonstrate that the proposed controller can significantly improve the dynamical behavior of rotor-bearing systems with regard to resonances and instabilities.
Author (EI)
Damping; Finite Element Method; Fluid Films; Hysteresis;

Mathematical Models; Optimal Control; Rotors; Vibration Damping

19960039213

Modeling fluid inertia forces of short journal bearings for rotordynamic applications

El-Shafei, A., Cairo Univ, Egypt; Journal of Vibration and Acoustics, Transactions of the ASME; October 1995; ISSN 1048-9002; vol. 117, no. 4, pp. 462-469; In English; Copyright; Avail: Issuing Activity

It has been recently suggested that fluid inertia may play an important role in the dynamic behavior of rotors supported on journal bearings. This paper presents a model for fluid inertia forces in short cylindrical journal bearings based on an energy approximation. The inertialess velocity profiles predicted by the solution of Reynolds' equation are inserted in the axial momentum equation multiplied by the axial velocity profile and integrated across the film thickness, to obtain the pressure in short journal bearings including the fluid inertia effect. The pressure is then integrated to obtain the fluid inertia forces. It is shown that the inertia forces thus obtained are proportional to the usual radial, centripetal, tangential and coriolis accelerations of the journal, in addition to a nonlinear radial acceleration. Moreover, it is shown that the inertia forces contribute to the stiffness and damping characteristics of the journal bearings. The inertia coefficients of the bearings are obtained in cartesian and cylindrical coordinates, for both uncavitated and cavitated bearings, and are plotted versus the eccentricity ratio. The model thus obtained is an approximate analytical closed form model for fluid inertia forces in short journal bearings. Such a model is the most suitable for rotordynamic applications, particularly for time transient rotordynamic simulations.

Author (EI)

Fluid Dynamics; Journal Bearings; Mathematical Models; Rotors; Velocity Distribution

19960039683

Comparison of shaped piezoelectric actuators for divergence control

Ball, Jeffrey K., USAFA, USA; Jones, James D.; Journal of Intelligent Material Systems and Structures; September 1995; ISSN 1045-389X; vol. 6, no. 5, pp. 598-609; In English; Copyright; Avail: Issuing Activity

The characteristics and effectiveness of shaped piezo-actuators for use in controlling the divergence of a simplified forward swept wing model are analytically investigated. The forward swept wing is modeled as a simplified cantilever beam with surface mounted piezo-actuators on the upper surface of the beam. A constant electric field is applied to the actuator inducing a constant external force on the wing, and the effects of actuator location, size, thickness, and shape are evaluated using the principle of virtual work by maximizing the modal amplitude of the first bending mode. For control purposes, strain at the wing root is used as an error signal to minimize the beam deflection. Results suggest that the optimum actuator size should span the entire wing. The required actuator thickness for divergence control decreases with increasing airspeed due to the effectiveness softening of the wing in the presence of air loads. A uniform rectangular actuator is more effective for controlling divergence; however, a linearly shaped actuator is more efficient from the standpoint of control effectiveness per actuator weight. Application is currently limited by the large thicknesses and applied voltages required by the actuators to achieve effective divergence control. However, this investigation suggests that, because of the softening of the wing near divergence, only a small control effort is required to deform the wing thus allowing the airstream to act as the power source for control actuation.

Author (EI)

Actuators; Beams (Supports); Cantilever Beams; Electric Fields; Mechanical Measurement; Piezoelectricity; Swept Forward Wings; Wings

19960039684

Engineering feasibility of induced strain actuators for rotor blade active vibration control

Giurgiutiu, Victor, Virginia Polytechnic Inst and State Univ, USA; Chaudhry, Zaffir; Rogers, Craig A.; Journal of Intelligent Material Systems and Structures; September 1995; ISSN 1045-389X; vol. 6, no. 5, pp. 583-597; In English; Copyright; Avail: Issuing Activity

Rotor blade vibration reduction based on Higher Harmonic Control-Individual Blade Control (HHC-IBC) principles is presented as a possible area of application of Induced Strain Actuation (ISA). Recent work on achieving HHC-IBC through conventional and ISA means is reviewed; some common-base values are identified. From this, a bench-mark specification for a tentative HHC-IBC device based on the aerodynamic servo-flap principle operated through ISA means is developed. Values for the invariant quantities of energy, power, and force-displacement product are identified, along with actual displacement and force values of practical interest. The implementation feasibility of this specification into an actual ISA device is then discussed. The results show that indirect actuation through a displacement amplifier is found to be more feasible.

Author (EI)

Actuators; Flaps (Control Surfaces); Harmonic Control; Parameter Identification; Standards; Turbomachine Blades; Vibration Damping

19960040361

Design and development of a CMC interturbine seal

Khandelwal, P. K., Allison Engine Co, USA; Wildman, W. D.; Ceramic Engineering and Science Proceedings; July 1995; ISSN 0196-6219; vol. 16, no. 4, pp. 243-250; In English; Copyright; Avail: Issuing Activity

An Allison AE 3007 turbofan engine interturbine seal has been selected by the ARPA funded LC(sup 3) program to develop and demonstrate the feasibility of the RTM process to fabricate and engine test a structurally sound 3-D braided Nextel 312/Blackglas component. Preliminary finite element heat transfer and stress analysis of the seal was conducted using the predicted thermomechanical properties of 2-D Nicalon and Nextel 312 reinforced Blackglas composites and a typical engine duty cycle. Heat transfer analysis indicated the maximum operating temperature to be 649 C with a maximum thermal gradient of 24 C. The maximum principal stresses were calculated for both CMC systems in the hoop, radial, and axial direction using finite element analysis (FEA). The maximum stress of 37.9 MPa was determined to be in the axial direction for both the material systems. The total equivalent stress was 54.5 MPa with a maximum strain of 0.1168 mm/mm.
Author (EI)
Ceramic Matrix Composites; Finite Element Method; Resin Transfer Molding; Seals (Stoppers); Turbofan Engines

19960040867
Effects of coupling misalignment on vibrations of rotating machinery
Sekhar, A. S., Indian Inst of Technology, India; Prabhu, B. S.; Journal of Sound and Vibration; August 31 1995; ISSN 0022-460X; vol. 185, no. 4, pp. 655-671; In English; Copyright; Avail: Issuing Activity

Improper aligning of shafts through couplings often leads to severe vibration problems in many rotating machines. The rotor-bearing system is modelled using higher order finite elements by considering deflection, slope, shear force, bending moment with eight degrees of freedom per node. The reaction forces, moments developed due to flexible coupling misalignment are derived and introduced in the model. The imbalance response in two harmonics is evaluated. The increase in harmonics with misalignment can easily be modelled by using FEM analysis. The location of the coupling with respect to the bending mode shape has a strong influence on the vibrations.
Author (EI)
Alignment; Bending Moments; Couplings; Flexibility; Rotation; Rotors; Shafts (Machine Elements); Vibration

19960041216 Navy Experimental Diving Unit, Panama City, FL USA
Evaluation of RIX 4VX AIR/NITROX Compressor *Final Report*
Sullivan, George D., Navy Experimental Diving Unit, USA; Dec. 1995; 43p; In English
Report No.(s): AD-A304678; NEDU-15-95; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

In response to reference NAVSEA tasking, Navy Experimental Diving Unit (NEDU) tested the Rix 4VX Air/Nitrox Compressor from 25 Oct 95 to 27 Nov 95. The purpose of this test was to determine if the equipment was suitable for the ANU List. The RIX 4VX Air/Nitrox Compressor delivers acceptable breathing air at a capacity which meets the manufacturer's specification. It is recommended for inclusion on the ANU List.
DTIC
Compressors; Air Conditioning Equipment; Diving (Underwater); Breathing Apparatus

19960041468 NASA Langley Research Center, Hampton, VA USA
Design and evaluation of a bolted joint for a discrete carbon-epoxy rod-reinforced hat section
Rousseau, Carl Q., Bell Helicopter Co., USA; Baker, Donald J., NASA Langley Research Center, USA; Aug. 29, 1996; 24p; In English; 11th; DoD/NASA/FAA Conference on Fibrous Composites in Structural Design., 26-29 Aug. 1996, Fort Worth, TX, USA; Sponsored by Department of Defense, USA
Report No.(s): NASA-TM-111622; NAS 1.15:111622; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of prefabricated pultruded carbon-epoxy rods has reduced the manufacturing complexity and costs of stiffened composite panels while increasing the damage tolerance of the panels. However, repairability of these highly efficient discrete stiffeners has been a concern. Design, analysis, and test results are presented in this paper for a bolted-joint repair for the pultruded rod concept that is capable of efficiently transferring axial loads in a hat-section stiffener on the upper skin segment of a heavily loaded aircraft wing component. A tension and a compression joint design were evaluated. The tension joint design achieved approximately 1.0% strain in the carbon-epoxy rod-reinforced hat-section and failed in a metal fitting at 166% of the design ultimate load. The compression joint design failed in the carbon-epoxy rod-reinforced hat-section test specimen area at approximately 0.7% strain and at 110% of the design ultimate load. This strain level of 0.7% in compression is similar to the failure strain observed in previously reported carbon-epoxy rod-reinforced hat-section column tests.
Author
Epoxy Matrix Composites; Bolted Joints; Aircraft Structures; Reinforcement (Structures); Tensile Stress; Compressive Strength; Stress Analysis; Axial Stress; Dynamic Structural Analysis

19960041607 NASA Lewis Research Center, Cleveland, OH, USA
Comparison between numerically modeled and experimentally measured wave-rotor loss mechanisms
Paxson, Daniel E., NASA Lewis Research Cent, USA; Journal of Propulsion and Power; September 1995; ISSN 0748-4658; vol. 11, no. 5, pp. 908-914; In English; Copyright;

Avail: Issuing Activity

A numerical model has been developed that is capable of predicting the performance of a wave-rotor (pressure exchanger) of specified geometry over a wide range of operating conditions. The model can account for the major loss mechanisms of leakage from the tube ends, fluid viscosity, heat transfer to the tube walls, finite tube opening time, shock waves, and nonuniform port flows. It is a one-dimensional flow model that follows a single tube as it rotates past the various stationary ports. Since the model is relatively simple (i.e., one dimensional), it uses little computer time. This makes it suitable for design as well as analytical purposes. This article will present a brief description of the model and then discuss a comparison between the model predictions and several wave-rotor experiments.

Author (EI)

Angular Velocity; Geometry; Heat Transfer; Mathematical Models; Nonuniform Flow; One Dimensional Flow; Rotors; Shock Waves; Transit Time; Viscosity

19960041608

Stall inception in a multistage high-speed axial compressor

Hoying, Donald A., U.S. Air Force Wright Lab, USA; Journal of Propulsion and Power; September 1995; ISSN 0748-4658; vol. 11, no. 5, pp. 915-922; In English; Copyright; Avail: Issuing Activity

A comprehensive study has been conducted into the inception of stall in a multistage high-speed axial flow compressor. The compressor tested was a highly loaded, four-stage axial compressor representing the state of the art in current design technology. Data were taken at a variety of speeds, both with and without inlet distortion. High-frequency response pressure measurements were made on three of the four stages. The data were spatially Fourier analyzed for the existence of pressure waves traveling about the annulus of the compressor prior to stall. In addition, system identification methods were used to estimate the frequency and stability of such waves. In this test, these waves were found at nearly all conditions tested. However, the duration of the waves prior to stall differed markedly as a function of the speed of the compressor. The system identification results showed that the stability of these waves approached zero as the compressor was stalled.

Author (EI)

Compressibility Effects; Compressors; Estimating; Exponential Functions; Fourier Transformation; High Speed; Pressure Measurement; System Identification

19960041609

Thrust characteristics of a supersonic mixer ejector

Tillman, T. G., United Technologies Research Cent, USA; Presz, W. M., Jr.; Journal of Propulsion and Power; September 1995; ISSN 0748-4658; vol. 11, no. 5, pp. 931-937; In English; Copyright; Avail: Issuing Activity

This article describes recent findings relative to the thrust performance of supersonic mixer ejectors. Mixer ejectors are a candidate means to mix out the high-velocity engine exhaust on the High Speed Civil Transport (HSCT) aircraft, thereby reducing jet noise at takeoff and landing. In the present work, data and analyses are presented that demonstrate that mixer ejectors can provide rapid mixing of a supersonic jet for acoustic benefits, all while increasing aircraft system static thrust. Jet engine thrust data is presented that demonstrates that a properly designed choked mixer nozzle has essentially no thrust loss when compared to conventional axisymmetric nozzles and mixer ejector thrust gains are invariant over a range of pressure ratios that choke the lobed nozzle. Model data of higher pressure-ratio mixer ejectors (i.e., consistent with HSCT applications) are analyzed to provide relevant thrust parameters. Comparisons are made with a conventional slot-nozzle ejector. A principal finding of this study is that the mixer ejector thrust performance is particularly sensitive to secondary inlet flowfield conditions and geometry. With proper inlet geometries, mixer ejector thrust performance was found to substantially exceed that of the slot-nozzle ejector.

Author (EI)

Aircraft Landing; Civil Aviation; Ejectors; Exhaust Systems; Jet Engines; Mach Number; Mass Flow Rate; Pressure Ratio; Pumps; Supersonic Jet Flow; Supersonic Transports; Takeoff

19960042337

Effect of transverse shear on aeroelastic stability of a composite rotor blade

Jung, Sung Nam, Chonbuk Natl Univ, USA; Kim, Seung JO; AIAA Journal; August 1995; ISSN 0001-1452; vol. 33, no. 8, pp. 1541-1543; In English; Copyright; Avail: Issuing Activity

The effects of transverse shear on the aeroelastic analysis of a composite rotor having antisymmetric configuration are investigated by using the finite element method. The results reveal that, for this type of configuration, the incorporation of transverse shear influenced the system on both the frequency and damping in a dramatic manner: instabilities occurred at several ply orientation angles. It is vital from the analysis that the transverse shear flexibility should be kept for the analysis of composite rotor to get more enhanced results.

Author (EI)

Aerodynamics; Finite Element Method; Frequencies; Rotors; Shear Stress; Stability; Transverse Loads

19960043812

Buck/boost servo amplifier for direct-drive-valve actuation

Lin, Jea-Sen, Natl Taiwan Univ, USA; Chen, Chern-Lin; IEEE Transactions on Aerospace and Electronic Systems; July 1995; ISSN 0018-9251; vol. 31, no. 3, pp. 960-967; In English; Copyright; Avail: Issuing Activity

We analyze the bandwidth problem of the direct-drive-valve (DDV) flight-control actuation and present two new

high-performance Buck/Boost servo amplifiers for driving the force motor (FM) in this system. The designed function of the presented circuit is to improve the response speed of the output current of the simplifier by temporarily boosting its output voltage. A nonlinear pulsewidth modulated (PWM) scheme is also presented to linearize the closed-loop control characteristics of the amplifier. Experimental results show that the system beamwidth is enlarged from originally 150 Hz to 500 Hz.
Author (EI)
Actuators; Amplifiers; Electric Current; Electric Potential; Electromechanical Devices; Flight Control; Pulse Duration Modulation; Servomotors

19960044013
Probabilistic concepts for gas-turbine engine management
Pomfret, Chris J., Wright Lab, USA; Aerospace Engineering (Warrendale, Pennsylvania); July 1995; ISSN 0736-2536; vol. 15, no. 7, pp. 9-12; In English; Copyright; Avail: Issuing Activity

Engineers are studying probabilistic concepts as a means of providing a more realistic indication of how long gas-turbine engine components will last. With probabilistics, design equations would not only have more realistic input data, but the design engineer would be able to manage safety because the impact of a small change of input variable on the output (sensitivity) would be measured. In applying such concepts, proper account could be taken of the variations at the outset, giving both the engineer and user more confidence that they are in control of the component being designed.
Author (EI)
Aircraft Engines; Computerized Simulation; Engine Parts; Fatigue (Materials); Gas Turbine Engines; Gas Turbines; Probability Theory; Rotating Disks

19960044517 Oak Ridge National Lab., TN USA
Creep performance of candidate SiC and Si3N4 materials for land-based, gas turbine engine components
Wereszczak, Andrew A., Oak Ridge National Lab., USA; Kirkland, Timothy P., Oak Ridge National Lab., USA; [1996]; 10p; In English; 41th; American Society of Mechanical Engineers (ASME) InterNational Gas Turbine and Aeroengine Congress and Exposition, 10-13 Jun. 1996, Birmingham, UK
Contract(s)/Grant(s): DE-AC05-96OR-22464
Report No.(s): CONF-960608-3; DE96-006703; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Tensile creep-rupture of a commercial gas pressure sintered Si3N4 and a sintered SiC is examined at 1038, 1150, and 1350 C. These 2 ceramics are candidates for nozzles and combustor tiles that are to be retrofitted in land-based gas turbine engines, and there is interest in their high temperature performance over service times (ge) 10,000 h (14 months). For this long lifetime, a static tensile stress of 300 MPa at 1038/1150 C and 125 Mpa at 1350 C cannot be exceeded for Si3N4; for SiC, the corresponding numbers are 300 Mpa at 1038 C, 250 MPa at 1150 C, and 180 MPa at 1350 C. Creep-stress exponents for Si3N4 are 33, 17, and 8 for 1038, 1150, 1350 C; fatigue- stress exponents are equivalent to creep exponents, suggesting that the fatigue mechanism causing fracture is related to the creep mechanism. Little success was obtained in producing failure in SiC after several decades of time through exposure to appropriate tensile stress; if failure did not occur on loading, then the SiC specimens most often did not creep-rupture. Creep-stress exponents for the SiC were determined to be 57, 27, and 11 for 1038, 1150, and 1350 C. For SiC, the fatigue-stress exponents did not correlate as well with creep-stress exponents. Failures that occurred in the SiC were a result of slow crack growth that initiated from the surface.
DOE
Engine Parts; Tensile Stress; Gas Turbine Engines; Creep Properties; Creep Rupture Strength; Silicon Nitrides

19960046111
Modified influence coefficient method for balancing unsymmetrical rotor-bearing systems
Kang, Y., Chung Yuan Christian Univ, USA; Liu, C.-P.; Sheen, G.-J.; Journal of Sound and Vibration; July 11 1996; ISSN 0022-460X; vol. 194, no. 2, pp. 199-218; In English; Copyright; Avail: Issuing Activity

A formulation of influence coefficient matrices is derived from the equations of motion for unsymmetrical rotors by using a complex co-ordinate representation and the finite element method. Due to the unequal properties in the two principal directions, the present formulation results in two sets of modified influence coefficients. The formulation indicates that two trial masses placed in different directions are required in the two trial operations for each balancing plane. Also, from the analysis, the modified influence coefficients are found to be correlated to forward precession and imbalanced forces when the asymmetry of the bearings is considered. Therefore one requires forward precessions instead of measured displacements to calculate the influence coefficients and imbalance distribution. Several examples are presented to verify the validity of the present work.
Author (EI)
Influence Coefficient; Loads (Forces); Rotors

19960046195
Wave rotor optimization for gas turbine engine topping cycles
Wilson, Jack, NYMA, Inc, USA; Paxson, Daniel E.; Journal of Propulsion and Power; July 1996; ISSN 0748-4658; vol. 12, no. 4, pp. 778-785; In English; Copyright; Avail: Issuing Activity

Use of a wave rotor as a topping cycle for a gas turbine engine can improve specific power and reduce specific fuel consumption. Maximum improvement requires the wave ro-

tor to be optimized for best performance at the mass flow of the engine. The optimization is a tradeoff between losses because of friction and passage opening time and rotational effects. An experimentally validated, one-dimensional computational fluid dynamics code, which includes these effects, has been used to calculate wave rotor performance and find the optimum configuration. The technique is described, and results given, for wave rotors sized for engines with sea level mass flows of 4, 26, and 400 lb/s.
Author (EI)
Cogeneration; Energy Conversion; Fuel Consumption; Gas Turbines; Mass Flow; Rotors

19960046222
Solid-state actuation of rotor blade servo-flap for active vibration control
Giurgiutiu, Victor, Virginia Polytechnic Inst and State Univ, USA; Rogers, Craig A.; Rusovici, Razvan; Journal of Intelligent Material Systems and Structures; March 1996; ISSN 1045-389X; vol. 7, no. 2, pp. 192-202; In English; Copyright; Avail: Issuing Activity

The basic concepts and some innovative ideas associated with the analysis, design, and experimentation of induced-strain actuators for rotor blade aeroelastic vibration control are presented and discussed. A trailing-edge servo-flap actuated by a hydraulically-amplified large-displacement induced-strain actuator is considered. Design requirements based on extensive literature review are proposed and utilized. The principle of high-power induced-strain actuation, and the energy and energy-density of several commercially-available induced-strain actuators are presented. A full-scale proof-of-concept demonstrator, designation HAHDIS Mk. 1, was designed, built, and tested. Results from static and dynamic tests are presented and discussed. Good frequency response of the full-scale proof-of-concept demonstrator was proven in the range of 1 to 30 Hz in spite of the power and current limitations of the available electronic equipment.
Author (EI)
Active Control; Actuators; Harmonic Control; Rotors; Solid State; Turbomachine Blades; Vibration Damping

19960046692
Permanent-magnet rotor for a high-temperature superconducting bearing
Mulcahy, Thomas M., Argonne Natl Lab, USA; Hull, John R.; Uherka, Kenneth L.; Abboud, Robert G.; Wise, James H.; Carnegie, David W.; Bakis, Charles E.; Gabrys, Christopher W.; IEEE Transactions on Magnetics; July 1996; ISSN 0018-9464; vol. 32, no. 4, pt. 1, pp. 2609-2612; In English; Copyright; Avail: Issuing Activity

Design, fabrication, and performance of a 0.39-m diam., 6.8-kg flywheel rotor with only one bearing is discussed. to achieve low-loss energy storage, the rotor's segmented-ring permanent magnet (PM) is optimized for levitation and circumferential homogeneity. A PM figure of merit is proposed that appears to correlate with loss data. Pre compression of the PM with fiber-composite banding is necessary for practical rotor speeds.
Author (EI)
High Temperature; High Temperature Superconductors; Permanent Magnets; Rotors

19960035835 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Investigation of Residual Strength and Fatigue Life of Unstiffined Aluminum Panels with Multiple Site Damage
Cherry, Mark C., Air Force Inst. of Tech., USA; Dec. 1995; 151p; In English
Report No.(s): AD-A303773; AFIT/GAE/ENY/95D-06; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Multiple Site Damage (MSD) is the occurrence of small fatigue cracks at several sites within aircraft structures. This is important since it may lower the residual strength and fatigue life of the structure beyond what can be predicted using the damage tolerance technique based on a single crack, currently in use to design aircraft structures. This study investigated the effects of MSD on unstiffined panels. MSD usually occurs at rivet holes, or other stress concentration locations within an aircraft structure. This study simulated rivet holes with MSD, by using holes of constant diameter with small cracks, evenly spaced across the midspan of specimens. The objective of the study was to test the validity of the available analytical methods to predict the residual strength and fatigue life of panels with MSD. Residual strengths of large specimens with MSD were measured in two different configurations to test the applicability of five failure criteria. A total of ten residual Fatigue tests were also conducted in three configurations to test the ability of analytical methods to predict fatigue life. The analytical methods investigated in this study can provide an aircraft designer with a conservative estimate of the residual strength of aircraft structures with MSD damage. However, the three failure criteria considered in this study produced unconservative fatigue life predictions.
DTIC
Aircraft Structures; Fatigue Tests; Fatigue Life; Cracks; Aluminum; Panels; Rivets; Stress Concentration

19960038402 NASA Langley Research Center, Hampton, VA USA
STS-74/Mir photogrammetric appendage structural dynamics experiment
Welch, Sharon S., NASA Langley Research Center, USA; Gilbert, Michael G., NASA Langley Research Center, USA; Apr. 1996; 16p; In English; 37th; AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 15-17 Apr. 1996, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 236-03-22-01

Report No.(s): NASA-TM-110249; NAS 1.15:110249; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Photogrammetric Appendage Structural Dynamics Experiment (PASDE) is an InterNational Space Station (ISS) Phase-1 risk mitigation experiment. Phase-1 experiments are performed during docking missions of the U.S. Space Shuttle to the Russian Space Station Mir. The purpose of the experiment is to demonstrate the use of photogrammetric techniques for determination of structural dynamic mode parameters of solar arrays and other spacecraft appendages. Photogrammetric techniques are a low cost alternative to appendage mounted accelerometers for the ISS program. The objective of the first flight of PASDE, on STS-74 in November 1995, was to obtain video images of Mir Kvant-2 solar array response to various structural dynamic excitation events. More than 113 minutes of high quality structural response video data was collected during the mission. The PASDE experiment hardware consisted of three instruments each containing two video cameras, two video tape recorders, a modified video signal time inserter, and associated avionics boxes. The instruments were designed, fabricated, and tested at the NASA Langley Research Center in eight months. The flight hardware was integrated into standard Hitchhiker canisters at the NASA Goddard Space Flight Center and then installed into the Space Shuttle cargo bay in locations selected to achieve good video coverage and photogrammetric geometry.

Author

Mir Space Station; Space Shuttle Missions; Space Transportation System; Appendages; Avionics; Dynamic Structural Analysis; Photogrammetry; Video Tape Recorders; Video Signals; Video Data

13
GEOSCIENCES

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

19960038288 Department of Energy, Environmental Measurements Lab., New York, NY USA

Electronic design for the light experimental aircraft aerosol instrumentation package

Albert, B. J., Department of Energy, USA; Leifer, R., Department of Energy, USA; Nov. 1995; 97p; In English

Report No.(s): EML-573; DE96-005339; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

The electronic design for EML's light experimental aircraft (LEA) instrument package is presented in this report. The instrument package provides in situ sampling of ambient air aboard a LEA to characterize aerosols and gases in the lower atmosphere. It contains a condensation particle counter, an optical particle counter, two integrating nephelometers, and six impactors. Supporting instruments measure hydrocarbon gas and ozone concentrations, and a wide range of sensors are used to acquire meteorological data. Two small computer boards provide control and data logging for all of the instruments and sensors. Circuits were designed to allow accurate signal measurements by the computers and to provide automation of the instrument package during flight. Data records are processed and stored at 5-s intervals over a 2-h flight time.

DOE

Aircraft Instruments; Light Aircraft; Air Sampling; Research Aircraft; Instrument Packages; Optical Measuring Instruments

19960044495 NASA Goddard Space Flight Center, Greenbelt, MD USA

An airborne sunphotometer for use with helicopters

Walthall, C. L., Agricultural Research Service, USA; Halthore, R. N., Brookhaven National Lab., USA; Elman, G. C., Science Systems and Applications, Inc., USA; Schafer, J. R., Science Systems and Applications, Inc., USA; Markham, B. L., NASA Goddard Space Flight Center, USA; Apr. 1996; 14p; In English; 2nd; InterNational Airborne Remote Sensing Conference and Exhibition, 24-27 Jun. 1996, San Francisco, CA, USA

Contract(s)/Grant(s): DE-AC02-76CH-00016

Report No.(s): NASA-CR-199477; NAS 1.26:199477; BNL-63020; CONF-960613-3; DE96-010692; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

One solution for atmospheric correction and calibration of remotely sensed data from airborne platforms is the use of radiometrically calibrated instruments, sunphotometers and an atmospheric radiative transfer model. Sunphotometers are used to measure the direct solar irradiance at the level at which they are operating and the data are used in the computation of atmospheric optical depth. Atmospheric optical depth is an input to atmospheric correction algorithms that convert at-sensor radiance to required surface properties such as reflectance and temperature. Airborne sun photometry has thus far seen limited use and has not been used with a helicopter platform. The hardware, software, calibration and deployment of an automatic sun-tracking sunphotometer specifically designed for use on a helicopter are described. Sample data sets taken with the system during the 1994 Boreal Ecosystem and Atmosphere Study (BOREAS) are presented. The addition of the sun photometer to the helicopter system adds another tool for monitoring the environment and makes the helicopter remote sensing system capable of collecting calibrated, atmospherically corrected data independent of the need for measurements from other systems.

DOE

Remote Sensing; Photometers; Helicopters; Atmospheric Correction; Flying Platforms; Calibrating; Solar Radiation; Radiative Transfer; Automatic Control

19960038448 Danmarks Tekniske Bibliotek, Dept. of Fluid Dynamics., Lyngby, Denmark

Current research and development needs in wind energy technology

Pedersen, B. M., Danmarks Tekniske Bibliotek, Denmark; 1995; ISSN 0590-8809; 189p; In English; 27th; Meeting of Experts on Current Research and Development Needs in Wind Energy Technology, 11-12 Sep. 1995, Utrecht, Netherlands

Report No.(s): NEI-DK-2321; CONF-9509351; DE96-748185; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The meeting, hosted by NOVEM, the Netherlands Agency for Energy and the Environment, was attended by 22 people. The purpose of the meeting was to get an impression of how far the efforts spent until now on worldwide research and development have brought the general understanding of, and possibly solutions to, the various problems within wind energy technology - thereby providing some guidance as to where to go from now. In 1994 it was estimated that more than 100 million U.S. dollars was spent on R, D and D by those OECD countries which have a wind energy program, and that since 1974 at least 1000 mil. U.S. dollars must have been spent. The necessity of continued basic research within certain areas was recognized, and it was emphasized that the size of the research teams should always be greater than 'the critical mass'. There seemed to be consensus among all participants that the areas for continued research were the following: aerodynamics, aeroelasticity and load calculations, aeroacoustics (verification of fatigue calculation procedures for 3D stress distribution, establishing a data base of material properties), lightning protection measures, offshore installations (combined wind/wave loading, dynamics of support structures, wind and turbulence over the open sea), power conversion and wind turbine - grid interaction.

DOE

Dynamic Structural Analysis; Aeroacoustics; Aerodynamics; Aeroelasticity; Air Water Interactions; Wind Turbines; Stress Distribution; Loads (Forces); Fluid Dynamics

19960041540 National Renewable Energy Lab., Golden, CO USA

Experimental investigation of aerodynamic devices for wind turbine rotational speed control

Miller, L. Scott, Wichita State Univ., USA; Feb. 1996; 80p; In English

Contract(s)/Grant(s): DE-AC36-83CH-10093

Report No.(s): NREL/TP-441-20507; DE96-000540; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

An experimental investigation was undertaken to further evaluate and enhance the performance of an aerodynamic device for wind turbine overspeed protection and power modulation applications. The trailing-edge device, known as the Spoiler-Flap, was examined in detail during wind tunnel tests. The impact of hp length, vent angle, pivot point and chord variations on aerodynamic and hinge moment characteristics were evaluated and a best overall configuration was identified. Based on this effort, a 40% chord device with a 1% hp length and 40 degree vent angle offers improved performance potential for wind turbine applications. This specific configuration appears to offer good suction coefficient performance for both turbine power modulation and overspeed (i.e., aerodynamic braking) applications. Device hinge moment loads improved (compared to other devices investigated) in magnitude and the impact of surface roughness was found to be minimal.

DOE

Aerodynamic Brakes; Wind Turbines; Turbines; Spoilers; Speed Control; Flapping

19960035824 Boeing Commercial Airplane Co., Seattle, WA USA

Scheduled Civil Aircraft Emission Inventories for 1976 and 1984: Database Development and Analysis *Final Report*

Baughcum, Steven L., Boeing Commercial Airplane Co., USA; Henderson, Stephen C., Boeing Commercial Airplane Co., USA; Tritz, Terrance G., Boeing Commercial Airplane Co., USA; Jun. 1996; 157p; In English

Contract(s)/Grant(s): NAS1-19360; RTOP 538-08-12-01

Report No.(s): NASA-CR-4722; NAS 1.26:4722; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report describes the development of a three-dimensional database of aircraft fuel burn and emissions (fuel burned, NOx, CO, and hydrocarbons) from scheduled commercial aircraft for four months (February, May, August, and November) of 1976 and 1984. Combining this data with earlier published data for 1990 and 1992, trend analyses for fuel burned, NOx, carbon monoxide, and hydrocarbons were calculated for selected regions (global, North America, Europe, North Atlantic, and North Pacific). These emissions inventories are available for use by atmospheric scientists conducting the Atmospheric Effects of Aviation Project (AEAP) modeling studies. Fuel burned and emissions of nitrogen oxides (NOx as NO2), carbon monoxide, and hydrocarbons have been calculated on a 1 degree latitude x 1 degree longitude x 1 kilometer altitude grid and delivered to NASA as electronic files.

Author

Civil Aviation; Commercial Aircraft; Air Pollution; Exhaust Emission; Data Bases; Trend Analysis; Inventories

19960036883 Air Force Center for Environmental Excellence, Brooks AFB, TX USA

Environmental Impact Statement: Disposal of K. I. Sawyer Air Force Base, Michigan, Volume 1 *Final Report*

Feb. 1996; 531p; In English

Report No.(s): AD-A304134; No Copyright; Avail: CASI;

A23, Hardcopy; A04, Microfiche

Pursuant to the Defense Base Closure and Realignment Act, K. I. Sawyer AFB was closed in September 1995. This Environmental Impact Statement has been prepared in accordance with the National Environmental Policy Act to analyze the potential environmental consequences of the disposal and reasonable alternatives for reuse of the base. The document includes analyses of community setting, land use and aesthetics, transportation, utilities, hazardous materials and hazardous waste management, geology and soils, water resources, air quality, noise, biological resources, cultural resources, and environmental justice. Four reuse alternatives were examined: a Proposed Action that features air cargo, regional aircraft maintenance, regional passenger, and general aviation uses of the runway with an industrial component being developed in the military family housing area; an InterNational Wayport Alternative that consists of interNational passenger, air cargo, and aircraft maintenance uses, as well as regional passenger and general aviation uses, and a large residential area; a Commercial Aviation Alternative that proposes a regional commercial airport with an Upper Peninsula vocational/educational training facility; and a Recreation Alternative that would retain more than 80 percent of the base for public facilities recreation land uses. All al ternatives include industrial, institutional, commercial, and residential uses. A No-Action Alternative, which would entail no reuse of the base property, was also evaluated. Potential environmental impacts are increased aircraft and traffic-related noise levels, traffic, and emissions of air pollutants over closure baseline conditions. Roadway improvements may be needed to prevent unacceptable traffic congestion.

DTIC

Aircraft Maintenance; Environment Management; Land Use; Air Quality; Noise Intensity; Geology; Water Resources; Residential Areas

19960036899 Air Force Center for Environmental Excellence, Brooks AFB, TX USA

Environmental Impact Statement: Disposal of K. I. Sawyer Air Force Base, Michigan, Volume 2, Appendices ***Final Report***

Feb. 1996; 250p; In English

Report No.(s): AD-A304135; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Pursuant to the Defense Base Closure and Realignment Act, K. I. Sawyer AFB was closed in September 1995. This Environmental Impact Statement has been prepared in accordance with the National Environmental Policy Act to analyze the potential environmental consequences of the disposal and reasonable alternatives for reuse of the base. The document includes analyses of community setting, land use and aesthetics, transportation, utilities, hazardous materials and hazardous waste management, geology and soils, water resources, air quality, noise, biological resources, cultural resources, and environmental justice. Four reuse alternatives were examined: a Proposed Action that features air cargo, regional aircraft maintenance, regional passenger, and general aviation uses of the runway with an industrial component being developed in the military family housing area; an InterNational Wayport Alternative that consists of interNational passenger, air cargo, and aircraft maintenance uses, as well as regional passenger and general aviation uses, and a large residential area; a Commercial Aviation Alternative that proposes a regional commercial airport with an Upper Peninsula vocational/education al training facility; and a Recreation Alternative that would retain more than 80 percent of the base for public facilities recreation land uses. All alternatives include industrial, institutional, commercial, and residential uses. A No-Action Alternative, which would entail no reuse of the base property, was also evaluated. Potential environmental impacts are increased aircraft and traffic-related noise levels, traffic, and emissions of air pollutants over closure baseline conditions. Roadway improvements may be needed to prevent unacceptable traffic congestion.

DTIC

Aircraft Maintenance; Environment Management; Land Use; Geology; Noise Intensity; Residential Areas; SOIls; Air Quality; Waste Disposal

19960038445 Boeing Commercial Airplane Co., Seattle, WA USA

Scheduled civil aircraft emission inventories for 1992: Database development and analysis ***Final Report***

Baughcum, Steven L., Boeing Commercial Airplane Co., USA; Tritz, Terrance G., Boeing Commercial Airplane Co., USA; Henderson, Stephen C., Boeing Commercial Airplane Co., USA; Pickett, David C., Boeing Commercial Airplane Co., USA; Apr. 1996; 216p; In English

Contract(s)/Grant(s): NAS1-19360; RTOP 538-08-12-01

Report No.(s): NASA-CR-4700; NAS 1.26:4700; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This report describes the development of a three-dimensional database of aircraft fuel burn and emissions (fuel burned, NOx, CO, and hydrocarbons) from scheduled commercial aircraft for each month of 1992. The seasonal variation in aircraft emissions was calculated for selected regions (global, North America, Europe, North Atlantic, and North Pacific). A series of parametric calculations were done to quantify the possible errors introduced from making approximations necessary to calculate the global emission inventory. The effects of wind, temperature, load factor, payload, and fuel tankering on fuel burn were evaluated to identify how they might affect the accuracy of aircraft emission inventories. These emissions inventories are available for use by atmospheric scientists conducting the Atmospheric Effects of Aviation Project (AEAP) modeling studies. Fuel burned and emissions of nitrogen oxides (NOx as N02), carbon monoxide, and hydrocarbons have been calculated on a 1 degree lati-

tude x 1 degree longitude x 1 kilometer altitude grid and delivered to NASA as electronic files.
Author
Aircraft Fuels; Exhaust Emission; Exhaust Gases; Atmospheric Effects; Air Pollution; Pollution Monitoring; Inventories

19960035580 Federal Aviation Administration, Technical Center., Atlantic City, NJ USA
Integrated Terminal Weather System (ITWS) 1994 demonstration phase OT&E *Final Report*
Yastrop, Gloria, Dimensions InterNational, Inc., USA; Smythe, Glenn, Dimensions InterNational, Inc., USA; Weiss, Thomas M., Federal Aviation Administration, USA; Nov. 1995; 111p; In English
Report No.(s): AD-A303702; DOT/FAA/CT-TN95/52; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Integrated Terminal Weather System (ITWS) will produce a fully automated, integrated terminal weather information system to improve safety, efficiency, and capacity of terminal area aviation operations. The ITWS will acquire data from Federal Aviation Administration (FAA) and National Weather Service (NWS) weather sensors as well as aircraft in flight to provide FAA air traffic personnel with products that require no meteorological interpretation. These products include current terminal area weather and near-term predictions of significant weather phenomena (e.g., microbursts, wind shear, gust fronts, precipitation, lightning, terminal winds, etc.). A Demonstration/Validation (DEMVAL) of ITWS prototypes was conducted at Memphis and Orlando InterNational Airports (MEM) (MCO) and the Memphis and Jacksonville Air Route Traffic Control Centers (ARTCC) during the summer of 1994. ITWS products were evaluated for operational suitability, usefulness, and meteorological validity. Questionnaires were completed by air traffic controllers, supervisors, and traffic managers at the completion of the DEMVAL. This report summarizes the results of the meteorological data analysis and questionnaire results, as determined by ACT-320. The resolution of Critical Operational Issues (COl) are also discussed. The results of these analyses indicated that during the DEMVAL: (1) The ITWS products (a) were useful during operationally significant weather, (b) were displayed without the need for meteorological interpretation, and (c) enhanced supervisor effectiveness in traffic planning/management during adverse weather; (2) Terminal airspace and runways were utilized more efficiently when the ITWS was operational; and (3) The ITWS reduced perceived controller workload during adverse weather conditions in the terminal area.
DTIC
Air Traffic Control; Meteorological Services; Weather Forecasting; Aviation Meteorology; Aircraft Hazards; Ground Based Control; Workloads (Psychophysiology); Air Traffic Controllers (Personnel); National Airspace System

19960038235 NASA Kennedy Space Center, Applied Meteorology Unit., Cocoa Beach, FL USA
Verification and implementation of microburst day potential index (MDPI) and wind INDEX (WINDEX) forecasting tools at Cape Canaveral Air Station
Wheeler, Mark, NASA Kennedy Space Center, USA; 1996; 32p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS10-11844
Report No.(s): NASA-CR-201354; NAS 1.26:201354; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report details the research, development, utility, verification and transition on wet microburst forecasting and detection the Applied Meteorology Unit (AMU) did in support of ground and launch operations at Kennedy Space Center (KSC) and Cape Canaveral Air Station (CCAS). The unforecasted wind event on 16 August 1994 of 33.5 ms-1 (65 knots) at the Shuttle Landing Facility raised the issue of wet microburst detection and forecasting. The AMU researched and analyzed the downburst wind event and determined it was a wet microburst event. A program was developed for operational use on the Meteorological Interactive Data Display System (MIDDS) weather system to analyze, compute and display Theta(epsilon) profiles, the microburst day potential index (MDPI), and wind index (WINDEX) maximum wind gust value. Key microburst nowcasting signatures using the WSR-88D data were highlighted. Verification of the data sets indicated that the MDPI has good potential in alerting the duty forecaster to the potential of wet microburst and the WINDEX values computed from the hourly surface data do have potential in showing a trend for the maximum gust potential. WINDEX should help in filling in the temporal hole between the MDPI on the last Cape Canaveral rawinsonde and the nowcasting radar data tools.
Author
Display Devices; Microbursts (Meteorology); Flight Hazards; Wind Shear; Rawinsondes; Radar Data; Nowcasting; Gusts; Meteorological Radar

19960041243 SRI InterNational Corp., Geoscience and Engineering Center., Menlo Park, CA USA
DC-8 scanning lidar characterization of aircraft contrails and cirrus clouds *Semiannual Report*
Nielsen, Norman B., SRI InterNational Corp., USA; Uthe, Edward E., Principal Investigator, SRI InterNational Corp., USA; Aug. 13, 1996; 18p; In English
Contract(s)/Grant(s): NCC2-885
Report No.(s): NASA-CR-201902; NAS 1.26:201902; SRI Project 6555; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Subsonic Assessment (SASS) element of the overall Atmospheric Effects of Aviation Project (AEAP) was initiated by NASA to assess the atmospheric impact of subsonic aircraft. SRI was awarded a project to develop and test a scanning backscatter lidar for installation on the NASA DC-8

(year 1), participate in the Subsonic Aircraft: Contrail and Cloud Effects Special Study (SUCCESS) field program (year 2), and conduct a comprehensive analysis of field data (year 3). A scanning mirror pod attached to the DC-8 aircraft provides for scanning lidar observations ahead of the DC-8 and fixed-angle upward or downward observations. The lidar system installed within the DC-8 transmits 275 MJ at 1.06 gm wavelength or about 130 mJ at 1.06 and 0.53 gm simultaneously. Range-resolved aerosol backscatter is displayed in real time in terms of cloud/contrail spatial distributions. The objectives of the project are to map contrail/cloud vertical distributions ahead of DC-8; provide DC-8 guidance into enhanced scattering layers; document DC-8 flight path intersection of contrail and cloud geometries (in-situ measurement positions relative to cloud/contrail shape and an extension of in-situ measurements into the vertical -- integrated contrail/cloud properties); analyze contrail/cloud radiative properties with LIRAD (combined lidar and radiometry) technique; evaluate mean particle sizes of aircraft emissions from two-wavelength observations; study contrail/cloud interactions, diffusion, and mass decay/growth; and make observations in the near-field of aircraft engine emissions. The scanning mirror pod may also provide a scanning capability for other remote sensing instruments.
Derived from text
Atmospheric Effects; Dc 8 Aircraft; Contrails; Cirrus Clouds; Optical Radar; Cloud Physics; Aircraft Instruments; Spatial Distribution; Optical Measurement; Pods (External Stores)

14
LIFE SCIENCES

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

19960039131
Chemical constitution and abrasive wear behaviour of pangolin scales
Tong, J., Jilin Univ, China; Ren, L.-Q.; Chen, B.-C.; Journal of Materials Science Letters; October 15 1995; ISSN 0261-8028; vol. 14, no. 20, pp. 1468-1470; In English; Copyright; Avail: Issuing Activity

Adhesion, friction, and abrasive wear of soil engaging components of agricultural machines and implements seriously decrease their efficiency and quality in working. Chen et al. have carried out bionics research on methods of soil adhesion and friction based on the fact that soil animals can move in soil without soil sticking to them. In this study, the scales used for experiments are taken from a pangolin. Specimens are cut from the scales, and polished and cleaned for XRD and amino acid analysis. Two types of specimens are prepared. Two different grades of quartz sand and bentonite of 76 micron diameter are used as abrasive. The abrasion test is conducted on a rotary disc type abrasive wear tester. The abrasion depth is recorded after the tests.
Author (EI)
Adhesion; Angle of Attack; Biology; Composition (Property); Wear; X Ray Diffraction

19960035579 Armstrong Lab., Human Resources Directorate; Manpower and Personnel Research Div., Brooks AFB, TX USA
Cognitive technology extends the work environment and accelerates learning in complex jobs *Interim Report, May 1993 - Nov. 1993*
Gott, Sherrie P., Armstrong Lab., USA; Sep. 1995; 25p; In English; 1st; InterNational Cognitive Technology Conference, 24-27 Aug. 1995, Hong Kong, China
Contract(s)/Grant(s): AF Proj. 2949
Report No.(s): AD-A303597; AL/HR-TP-1995-0025; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Instructional technology that is grounded in cognitive theory is used as the medium to accelerate the acquisition ot complex problem solving skills. The use of an intelligent tutoring system to teach troubleshooting literally expands the learning environment by providing a simulated representation of the actual work environment where trainees work a graded series of troubleshooting scenarios. Scenarios are sequenced t9 promote successive approximations of mature practice as trainees work more and more difficult problems in the 'forgiving' tutor environment, where they learn by doing and reflecting on their own solution vis-a-vis an exemplar master solution. In a controlled experiment, experimental apprentice subjects outperformed their control counterpart on the two Verbal Troubleshooting Posttests (t39= -4.04, p = .000; t39 = -3.72, p = .001) and on the paper and pencil posflest (r39 = -2.77, p = .009). After tutoring, scores obtained by apprentice subjects (having about 3 years' AF experience) rivaled those of Master technicians having over 10 years' experience in F 15 avion ics maintenance. The dramatic results are attributed to (a) cognitive models as input to instruction; (b) the sequence of instructional events; (c) situated learning in a constructivist instructional environment, and (d) the sociology surrounding the learning system. Topics (c) and (d) are discussed with special attention.
DTIC
Problem Solving; Verbal Communication; Education; Avionics; Computerized Simulation; Human Performance; Computer Assisted Instruction

19960034389 California Univ., Graduate Div.; Mechanical Engineering Dept., Davis, CA USA
Measurement of human pilot dynamic characteristics in flight simulation *Final Report*
Reedy, James T., California Univ., USA; 1987; 95p; In English

Contract(s)/Grant(s): NCC2-241
Report No.(s): NASA-CR-201099; NAS 1.26:201099; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Fast Fourier Transform (FFT) and Least Square Error (LSE) estimation techniques were applied to the problem of identifying pilot-vehicle dynamic characteristics in flight simulation. A brief investigation of the effects of noise, input bandwidth and system delay upon the FFT and LSE techniques was undertaken using synthetic data. Data from a piloted simulation conducted at NASA Ames Research Center was then analyzed. The simulation was performed in the NASA Ames Research Center Variable Stability CH-47B helicopter operating in fixed-basis simulator mode. The piloting task consisted of maintaining the simulated vehicle over a moving hover pad whose motion was described by a random-appearing sum of sinusoids. The two test subjects used a head-down, color cathode ray tube (CRT) display for guidance and control information. Test configurations differed in the number of axes being controlled by the pilot (longitudinal only versus longitudinal and lateral), and in the presence or absence of an important display indicator called an 'acceleration ball'. A number of different pilot-vehicle transfer functions were measured, and where appropriate, qualitatively compared with theoretical pilot- vehicle models. Some indirect evidence suggesting pursuit behavior on the part of the test subjects is discussed.
Author
Flight Simulation; Fast Fourier Transformations; Least Squares Method; Pilot Performance

19960045365 Advisory Group for Aerospace Research and Development, Aerospace Medical Panel, Neuilly-Sur-Seine, France
Anthropomorphic Dummies for Crash and Escape System Testing *Mannequins Anthropometriques Utilises Lors des Tests d'Impact et d'Ejection*
Jul. 1996; 120p; In English
Report No.(s): AGARD-AR-330; ISBN-92-836-1039-3; Copyright Waived; Avail: CASI; A06, Hardcopy; A02, Microfiche

Anthropomorphic dummies for crash and escape system testing have been used by military and civilian agencies for many years to assess, develop and standardize safer occupant restraint systems for land and air vehicles. The automotive industry has spent considerable effort in designing crash test dummies that are biofidelic; i.e., dummies that duplicate the properties of a representative human subject on which injury risk is to be assessed. This advisory report addresses the status and direction of the technology of aircraft ejection and automotive crash test dummies from the point of view of the following: historical review of important dummies developed in NATO; human biomechanical response requirements of current adult dummies; anthropometry of current adult dummies; injury tolerance criteria for impact exposure of these dummies; dummy instrumentation and data acquisition systems; new developments in dummies; mathematical models as human surrogates; and dummy users in NATO. Recommendations include the need for the following: relating aircraft system effectiveness testing to dummy injury criteria; full line of dummy sizes to accommodate entire flying population; enhanced dummy instrumentation and data acquisition systems; affordability of dummy acquisition, use and maintenance; and validation and increased use of mathematical models as human surrogates.
Author
Dummies; Escape Systems; Crashes; Anthropometry; Safety Devices; Ejection Seats; Bionics; Test Equipment

15
MATHEMATICAL AND COMPUTER SCIENCES

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

19960036581
Flow simulation and drag anatomy for antitank projectile configurations
Mikhail, Ameer G., U.S. Army Ballistic Research Lab, USA; Journal of Spacecraft and Rockets; November 1995; ISSN 0022-4650; vol. 32, no. 6, pp. 1079-1081; In English; Copyright; Avail: Issuing Activity

In order to provide the drag anatomy of the geometrical component of the projectile body, for both the spike- and the cone-nosed projectiles, at high supersonic speeds and zero angle of attack, seven different cases were computed for three projectile configurations. These configuration encompass the two categories of antiplank projectiles. The computations were made at both wind-tunnel and sea-level Reynolds numbers.
Author (EI)
Angle of Attack; Computational Geometry; Computerized Simulation; Drag; Fluid Flow; Projectiles; Supersonic Flow; Supersonic Speed; Velocity; Vortex Generators

19960044017
Partitioned procedures for the transient solution of coupled aeroelastic problems part I: model problem, theory and two-dimensional application
Piperno, Serge, CERMICS, France; Farhat, Charbel; Larrouturou, Bernard; Computer Methods in Applied Mechanics and Engineering; June 15 1995; ISSN 0045-7825; vol. 124, no. 1-2, pp. 79-112; In English; Copyright; Avail: Issuing Activity

In order to predict the dynamic response of a flexible structure in a fluid flow, the equations of motion of the struc-

ture and the fluid must be solved simultaneously. In this paper we present several partitioned procedures for time-integrating this focus coupled problem and discuss their merits in terms of accuracy, stability, heterogeneous computing, I/O transfers, subcycling and parallel processing. All theoretical results are derived for a one-dimensional piston model problem with a compressible flow, because the complete three-dimensional aeroelastic problem is difficult to analyze mathematically. However, the insight gained from the analysis of the coupled piston problem and the conclusions drawn from its numerical investigation are confirmed with the numerical simulation of the two-dimensional transient aeroelastic response of a flexible panel in a transonic non-linear Euler flow regime.
Author (EI)
Aerodynamics; Computational Fluid Dynamics; Computerized Simulation; Dynamic Response; Equations of Motion; Mathematical Models

19960048807
Geometric conservation laws for flow problems with moving boundaries and deformable meshes, and their impact on aeroelastic computations
Lesoinne, Michel, Univ of Colorado at Boulder, USA; Farhat, Charbel; Computer Methods in Applied Mechanics and Engineering; July 15 1996; ISSN 0045-7825; vol. 134, no. 1-2, pp. 71-90; In English; In English; Copyright; Avail: Issuing Activity

Numerical simulations of flow problems with moving boundaries commonly require the solution of the fluid equations on unstructured and deformable dynamic meshes. In this paper, we present a unified theory for deriving Geometric Conservation Laws (GCLs) for such problems. We consider several popular discretization methods for the spatial approximation of the flow equations including the Arbitrary Lagrangian-Eulerian (ALE) finite volume and finite element schemes, and space-time stabilized finite element formulations. We show that, except for the case of the space-time discretization method, the GCLs impose important constraints on the algorithms employed for time-integrating the semi-discrete equations governing the fluid and dynamic mesh motions. We address the impact of these constraints on the solution of coupled aeroelastic problems, and highlight the importance of the GCLs with an illustration of their effect on the computation of the transient aeroelastic response of a flat panel in transonic flow.
Author (EI)
Aerodynamics; Approximation; Boundary Value Problems; Computational Fluid Dynamics; Computational Geometry; Conservation Laws; Finite Volume Method; Fluid Flow

19960049380
Instrumentation analysis using parameter estimation of simulated data
Thomas, Justin Wakefield, Science Applications Int Corp, USA; Hall, Charles E., Jr.; Journal of Guidance, Control, and Dynamics; September 1996; ISSN 0731-5090; vol. 19, no. 5, pp. 1191-1193; In English; In English; Copyright; Avail: Issuing Activity

The preliminary analysis of the simulated instrumentation system indicated that the slow dynamics of the alpha vane transducer have an adverse effect on the quality of the data obtained from the parameter estimation techniques. An analog lead circuit has been developed and modeled in the simulated instrumentation system. by reducing the lag in the ankle of attack signal, the accuracy of the estimates significantly improved. This success shows the benefits of preliminary analysis using high-fidelity simulated flight test data.
Author (EI)
Aerodynamics; Aircraft Models; Analog Circuits; Computer Programs; Computerized Simulation; Data Reduction; Flight Simulators; Flight Tests; Parameter Identification

19960049518
Analysis of hypersonic shock-wave laminar boundary-layer interaction phenomena
Grasso, F., Universita di Roma 'La Sapienza', Italy; Marini, M.; Computers & Fluids; July 1996; ISSN 0045-7930; vol. 25, no. 6, pp. 561-581; In English; In English; Copyright; Avail: Issuing Activity

In the present paper hypersonic viscous flows dominated by strong shock-wave laminar boundary-layer interactions over wing-flap and wing-fuselage junction configurations have been analyzed. The effects of the control surface deflection angle, leading edge shape and viscous interaction parameter on the flowfield have been evaluated. Scaling laws for the upstream influence, peak heating and aerodynamic coefficients have been established by means of numerical simulations and theoretical considerations.
Author (EI)
Boundary Layers; Computational Fluid Dynamics; Computer Techniques; Control Surfaces; Diagnosis; Hydrodynamics; Hypersonic Flow; Leading Edges; Scaling Laws; Shock Waves; Wing Flaps

19960038338 NASA Ames Research Center, Moffett Field, CA USA
Genetic algorithms in conceptual design of a light-weight, low-noise, tilt-rotor aircraft *Final Report*
Wells, Valana L., Arizona State Univ., USA; Jun. 1996; 8p; In English
Contract(s)/Grant(s): NAG2-882
Report No.(s): NASA-CR-201426; NAS 1.26:201426; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This report outlines research accomplishments in the area of using genetic algorithms (GA) for the design and optimization of rotorcraft. It discusses the genetic algorithm as a search and optimization tool, outlines a procedure for using the GA

in the conceptual design of helicopters, and applies the GA method to the acoustic design of rotors.
Author
Tilt Rotor Aircraft; Helicopters; Genetic Algorithms; Aircraft Noise; Aeroacoustics; Noise Prediction (Aircraft)

19960039595
Multistage integration model for human egomotion perception
Zacharias, Greg L., Charles River Analytics, USA; Miao, Adam X.; Journal of Guidance, Control, and Dynamics; September 1995; ISSN 0731-5090; vol. 18, no. 5, pp. 937-944; In English; Copyright; Avail: Issuing Activity

Human computational vision models that attempt to account for the dynamic perception of egomotion and relative depth typically assume a common three-stage process: first, compute the optical flow field based on the dynamically changing image; second, estimate the egomotion states based on the flow; and third, estimate the relative depth/shape based on the egomotion states and possibly on a model of the viewed surface. We propose a model more in line with recent work in human vision, employing multistage integration. Here the dynamic image is first processed to generate spatial and temporal image gradients that drive a mutually interconnected state estimator and depth/shape estimator. The state estimator uses the image gradient information in combination with a depth/shape estimate of the viewed surface and an assumed model of the viewer's dynamics to generate current state estimates; in tandem, the depth/shape estimator uses the image gradient information in combination with the viewer's state estimate and assumed shape model to generate current depth/shape estimates. In this paper, we describe the model and compare model predictions with empirical data.
Author (EI)
Computer Vision; Flight Simulators; Mathematical Models; Optical Flow (Image Analysis); Sensory Perception; Statistical Analysis; Vision

19960040021
New evolutionary direction operator for genetic algorithms
Yamamoto, Kenji, Tohoku Univ, Japan; Inoue, Osamu; AIAA Journal; October 1995; ISSN 0001-1452; vol. 33, no. 10, pp. 1990-1993; In English; Copyright; Avail: Issuing Activity

An evolutionary direction operator for genetic algorithms has been proposed. The maximum value search problem of a two-dimensional multiple-peak function was solved. Results indicate that the evolutionary direction operator was very effective. According to the operator, the evolutionary direction was determined simply, and thus computation time was reduced if compared with the gradient-based optimizers that require evaluation of gradients.
Author (EI)
Aerodynamics; Genetic Algorithms; Optimization; Problem Solving

19960035684 Naval Postgraduate School, Monterey, CA USA
A Model for Analyzing Aircraft Maintenance Man-Hour Costs and the Impact of Expert Systems
Schanz, Keith E., Naval Postgraduate School, USA; Shirkey, Donnie L., Naval Postgraduate School, USA; Jun. 1995; 136p; In English
Report No.(s): AD-A304291; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The process for determining the impact on direct labor maintenance man-hours by applying expert systems to diagnosis aircraft discrepancies is addressed. Based on field interviews with Navy enlisted maintenance technicians and technical representatives, average direct labor maintenance man-hour cost savings are projected by applying expert systems. The interviews contained quantitative and qualitative information to formulate the potential cost savings. to enhance future investigative efforts, an empirical model is developed by the authors. The model categorizes failed components based on their average fault isolation times or beyond economical repair status of the organization. Based upon the categorization of components, the potential maintenance man-hours cost savings can be projected when applying expert systems to help resolve difficult and complex aircraft discrepancies.
DTIC
Aircraft Maintenance; Labor; Maintenance; Expert Systems

19960036508
Optimal nonlinear estimation for aircraft flight control in wind shear
Mulgund, Sandeep S., Charles River Analytics Inc, USA; Stengel, Robert F.; Automatica; January 1996; ISSN 0005-1098; vol. 32, no. 1, pp. 3-13; In English; Copyright; Avail: Issuing Activity

An Extended Kalman Filter (EKF) is developed to estimate the state of a jet transport aircraft. The EKF is based on the nonlinear longitudinal aircraft equations of motion, and it is designed to provide estimates of horizontal and vertical atmospheric wind inputs. The optimal state and disturbance estimates are incorporated in feedback control laws based on the aircraft's nonlinear inverse dynamics. The EKF produces accurate estimates, and the resultant flight trajectories are very similar to those obtained with perfect state feedback. The EKF is sensitive to uncertainty in the dynamic model, but much of the lost performance can be restored by treating the uncertainty as a random disturbance input.
Author (EI)
Control Equipment; Jet Aircraft; Microbursts (Meteorology); Nonlinear Systems; Optimal Control; State Estimation; Wind Effects; Wind Shear

19960036511

Nonlinear control of surge in axial compression systems

Badmus, O. O., Georgia Inst of Technology, USA; Chowdhury, S.; Nett, C. N.; Automatica; January 1996; ISSN 0005-1098; vol. 32, no. 1, pp. 59-70; In English; Copyright; Avail: Issuing Activity

This paper discusses the nonlinear control of surge in axial compression systems. A nonlinear model-based Luenberger-type observer is first developed from a simple incompressible flow model of an axial compressor rig; then the input-output feedback linearizing control technique is employed to derive an appropriate control law. The use of the output observer as the basis for the control design enables the reconstruction of approximate system states from a single output measurement, it enhances transient tracking of measured output, and it reduces the destabilizing effect of measurement noise in closed loop. The nonlinear controller described in this work achieves an implicit linearization of the dynamics between the measured output variable, the dynamic pressure at the compressor inlet and the system input variable (the throttle area parameter). The designed controller is validated by both simulation and experimental demonstration on an axial compressor experimental rig. The controlled system responses show adequate stabilization of the surge dynamics in the presence of impulsive and persistent disturbances in system conditions. Further evaluation of the overall controlled system performance is enhanced by comparisons with a linear surge controller. It is shown that gain scheduling along nominal conditions is not required to maintain uniform closed-loop performance, during tracking of setpoint changes, with the nonlinear controller.

Author (EI)

Compressors; Control Equipment; Feedback Control; Fluid Flow; Incompressible Flow; Nonlinear Systems; Surges

19960038760

Pole placement in optimal regulator by continuous pole-shifting

Ochi, Y., Natl Defense Acad, Japan; Kanai, K.; Journal of Guidance, Control, and Dynamics; November 1995; ISSN 0731-5090; vol. 18, no. 6, pp. 1253-1258; In English; Copyright; Avail: Issuing Activity

This paper presents a method of pole placement in the linear quadratic regulator and its application to the flight control system design. There are three features in the proposed method. First, a weighting matrix that gives desired closed-loop pole locations is obtained by solving a set of differential equations. They are derived from the characteristic equation of the Hamilton matrix. Second, poles can be placed exactly at the desired positions and arbitrarily except the symmetry of complex conjugate poles with respect to the real axis. Third, it is a diagonal weighting matrix that is obtained by the proposed method. The third feature makes output regulation with desired pole locations possible. After demonstrating the effectiveness of the method through a simple literature example, it is then applied to the F-4 aircraft's lateral dynamic model.

Author (EI)

Aircraft Models; Differential Equations; Feedback Control; Flight Control; Hamiltonian Functions; Linear Quadratic Regulator; Matrices (Mathematics); Matrix Theory; Optimal Control; Series Expansion; Taylor Series; Weighting Functions

19960038763

Neural-network-based scheme for sensor failure detection, identification, and accommodation

Napolitano, Marcello R., West Virginia Univ, USA; Neppach, Charles; Casdorph, Van; Naylor, Steve; Innocenti, Mario; Silvestri, Giovanni; Journal of Guidance, Control, and Dynamics; November 1995; ISSN 0731-5090; vol. 18, no. 6, pp. 1280-1286; In English; Copyright; Avail: Issuing Activity

This paper presents a neural-network-based approach for the problem of sensor failure detection, identification, and accommodation for a flight control system without physical redundancy in the sensors. The approach is based on the introduction of on-line learning neural network estimators. For a system with n sensors, a combination of a main neural network and a set of n decentralized neural networks achieves the design goal. The main neural network and the ith decentralized neural network detect and identify a failure of the ith sensor, whereas the output of the ith decentralized neural network accommodates for the failure by replacing the signal from the failed ith sensor with its estimate. The on-line learning for these neural network architectures is performed using the extended back-propagation algorithm. The document describes successful simulations of the sensor failure detection, identification, and accommodation process following both soft and hard sensor failures. The simulations have shown remarkable capabilities for this neural scheme.

Author (EI)

Detection; Flight Control; Neural Nets; Sensors; System Identification

19960038764

Resonance control of aircraft instabilities by smooth and continuous feedback

Pinsky, Mark A., Univ of Nevada, USA; Essary, Bill; Journal of Guidance, Control, and Dynamics; November 1995; ISSN 0731-5090; vol. 18, no. 6, pp. 1298-1304; In English; Copyright; Avail: Issuing Activity

Analysis and control of bifurcation phenomena occurring in high angle-of-attack aircraft flight have been the subject of a number of recent studies. It has been shown that smooth nonlinear feedback is capable of stabilizing nonlinear transient phenomena in a certain range of parameters of aircraft models. In a recent paper we presented an integrated approach employing the normal forms reduction methodology

for both analysis and control of aircraft instabilities. In this paper we describe a novel resonance control design approach that assumes feedback as a composition of continuous (nonsmooth) and smooth nonlinear components. We show that such compound resonance control matches superior performance with a reduction of feedback magnitude required for stabilization.
Author (EI)
Aircraft Guidance; Aircraft Models; Branching (Mathematics); Feedback; Nonlinear Systems; Resonance

19960039599
Nonlinear predictive control of feedback linearizable systems and flight control system design
Singh, Sahjendra N., Univ of Nevada, Las Vegas, Las Vegas, USA; Steinberg, Marc; Digirolamo, Robert D.; Journal of Guidance, Control, and Dynamics; September 1995; ISSN 0731-5090; vol. 18, no. 5, pp. 1023-1028; In English; Copyright; Avail: Issuing Activity

The question of output trajectory control of input-output feedback linearizable nonlinear dynamic systems using state variable feedback is considered. For the derivation of the predictive control law, a vector function s is chosen as a linear combination of the tracking error, its higher order derivatives, and the integral of the tracking error. The control law is obtained by the minimization of a quadratic function of the predicted value of s and the control input. It is shown that in the closed-loop system the trajectories are uniformly ultimately bounded in the presence of uncertainty in the system parameters. Based on these results, a flight control system for the trajectory control of the output variables pitch, sideslip, and roll angles (theta, beta, phi) using aileron, rudder, and elevator control is presented. Simulation results are obtained to show that precise simultaneous longitudinal and lateral maneuvers can be performed in spite of the uncertainty in the aerodynamic parameters.
Author (EI)
Control Equipment; Feedback Control; Flight Control; Linearization; Nonlinear Systems; Predictions; Trajectories

19960039601
Flexible vehicle control using quantitative feedback theory
Hess, R. A., Univ of California, Davis, Davis, USA; Henderson, D. K.; Journal of Guidance, Control, and Dynamics; September 1995; ISSN 0731-5090; vol. 18, no. 5, pp. 1062-1067; In English; Copyright; Avail: Issuing Activity

The design of a longitudinal pitch-axis flight control system for a flexible aircraft with uncertainty in the vehicle model is presented. This uncertainty includes the characteristics of the vehicle elastic mode. Quantitative feedback theory is used in the control system design. A level 1 handling qualities requirement is included in the control systems design specifications. This requirement is generated through pilot-vehicle analysis using a structural model of the human pilot and handling qualities sensitivity functions. Although two aerodynamic controls were available (elevator and forward vane), it is shown that elevator control alone can be used to meet the command-following, disturbance rejection, and handling qualities requirements.
Author (EI)
Aerodynamics; Aircraft Models; Control Surfaces; Control Systems Design; Control Theory; Feedback Control; Flexible Bodies; Flexible Wings; Flight Control; Robustness (Mathematics)

19960039604
Aircraft antilock brake system with neural networks and fuzzy logic
Tseng, H. Chris, Duke Univ, USA; Chi, Charlie W.; Journal of Guidance, Control, and Dynamics; September 1995; ISSN 0731-5090; vol. 18, no. 5, pp. 1113-1118; In English; Copyright; Avail: Issuing Activity

We explore the competitive concepts of neural network identification and fuzzy logic adaptive inference into the aircraft antilock brake system (ABS) design. The nonlinearities typically characterized by look-up tables are emulated with neural identifiers and subsequently integrated in the ABS design. The highly nonlinear aircraft dynamics coupled with varying operating conditions and uncertainties are handled well with the proposed rule-based fuzzy logic controller. The proposed methodology is shown to be robust under various runway ground conditions. The proposed aircraft ABS design with neural networks and fuzzy logic can persistently provide the maximum achievable traction force for deceleration purposes, as compared with other ABS and non-ABS schemes.
Author (EI)
Aerodynamic Characteristics; Aircraft Equipment; Aircraft Parts; Computer Techniques; Flight Characteristics; Fuzzy Sets; Neural Nets; System Identification; Tables (Data)

19960039608
Minimal time change detection algorithm for reconfigurable flight control systems
Kim, Sungwan, Univ of California, Los Angeles, Los Angeles, USA; Journal of Guidance, Control, and Dynamics; September 1995; ISSN 0731-5090; vol. 18, no. 5, pp. 1211-1212; In English; Copyright; Avail: Issuing Activity

There is a significant interest in enhancing current flight systems to reconfigure the controls in order to maintain adequate levels of performance even if there are complete failures in one or more of the actuators or sensors. In this paper, a new robust algorithm, called the minimal time change detection algorithm, that minimizes the time delay in detecting a change in a linear system for a fixed false-alarm probability is developed. The system identification process of this algorithm finds a new set of parameter values for the changed system. The regulator uses the new parameter values to build a new

control law. Hence, a reconfigurable control system can be designed that is suitable for a system that undergoes random changes.
Author (EI)
Algorithms; Change Detection; False Alarms; Flight Control; Linear Systems; Mathematical Models; Robustness (Mathematics); System Identification; Time Optimal Control

19960042175
Vibration reduction in rotorcraft using active control: a comparison of various approaches
Friedmann, Peretz P., Univ of California, USA; Millott, Thomas A.; Journal of Guidance, Control, and Dynamics; July 1995; ISSN 0731-5090; vol. 18, no. 4, pp. 664-673; In English; Copyright; Avail: Issuing Activity

This paper presents a concise review of the state of the art for vibration reduction using active controls. The principal approaches to vibration reduction in helicopters described in the paper are 1) higher harmonic control, 2) individual blade control, 3) vibration reduction using an actively controlled flap located on the blade, and 4) active control of structural response. The special attributes of the coupled rotor/flexible fuselage vibration reduction problem are also briefly discussed to emphasize that vibration reduction at the hub is not equivalent to acceleration reduction at specific fuselage locations. Based on the comparison of the various approaches, it appears that the actively controlled flap has remarkable potential for vibration reduction.
Author (EI)
Active Control; Dynamic Response; Fuselages; Harmonic Control; Rotary Wing Aircraft; Rotary Wings; Turbomachine Blades; Vibration Damping

19960045950
Adaptive control of feedback linearizable nonlinear systems with application to flight control
Singh, Sahjedra N., Univ of Nevada, USA; Steinberg, Marc; Journal of Guidance, Control, and Dynamics; July 1996; ISSN 0731-5090; vol. 19, no. 4, pp. 871-877; In English; Copyright; Avail: Issuing Activity

The question of output trajectory control of a class of input-output feedback linearizable nonlinear dynamical systems using state variable feedback in the presence of parameter uncertainty is considered. For the derivation of a control law, a hypersurface is chosen, which is a linear function of the tracking error, its derivatives, and the integral of the tracking error. An adaptive control law is derived such that in the closed-loop system the trajectory asymptotically converges to this hypersurface. For any trajectory evolving on this surface, the tracking error tends to zero. Based on these results, a new approach to the design of an adaptive flight control system is presented. In the closed-loop system, trajectory control of the sets of output variables roll angle, angle of attack, and sideslip angle (phi, alpha, beta) and roll, pitch, and sideslip angles (phi, theta, beta) using aileron, rudder, and elevator control is presented. Simulation results are obtained to show that precise simultaneous longitudinal and lateral maneuvers can be performed in spite of large uncertainty in the aerodynamic parameters.
Author (EI)
Adaptive Control; Feedback; Feedback Control; Flight Control; Nonlinear Systems; Trajectory Control

19960045951
Control of wing rock motion using adaptive feedback linearization
Monahemi, Mogen M., Univ of Maryland, USA; Krstic, Miroslav; Journal of Guidance, Control, and Dynamics; July 1996; ISSN 0731-5090; vol. 19, no. 4, pp. 905-912; In English; Copyright; Avail: Issuing Activity

The theory of adaptive control of feedback linearizable systems is applied to designing the control of wing rock motion with the extension of the technique to include tracking. The adaptation law is designed to adjust the aerodynamic parameters in the model. Precise tracking and maximum performance can be achieved if sufficient rolling moment derivative because of lateral control components are available. Case studies and simulation are carried out to illustrate the results.
Author (EI)
Adaptive Control; Aerodynamics; Aircraft Configurations; Delta Wings; Feedback Control; Linearization; Mathematical Models

19960045952
Multivariable control of the J-85 turbojet engine for full flight envelope operation
Lin, Shih-Tin, Natl Chung-Hsing Univ, USA; Lee, Chun-Mo; Journal of Guidance, Control, and Dynamics; July 1996; ISSN 0731-5090; vol. 19, no. 4, pp. 913-920; In English; Copyright; Avail: Issuing Activity

The design of a J-85 turbojet engine controller using Edmunds' method and gain scheduling techniques is presented. A nonlinear engine model was first linearized at 50 selected operating points throughout the flight power envelope of the J-85 engine. The operating points were selected based on the engine's altitude, Mach number, and compressor rotor speed. Edmunds' method was then used to design a linear controller for each operating point. The objective of this method is to design a simple controller, which achieves a desired performance criteria. Finally, for full flight envelope operation, two gain scheduling approaches were evaluated: 1) extended Kalman filter and 2) neural networks. The objectives of this research are to evaluate Edmunds' method for the design of a J-85 engine controller, as well as gain scheduling approaches for the full flight power envelope operation. After completing the controller design for 50 operation points, we found that Edmunds' method is very effective for this application. For

the gain scheduling approaches, simulation results show that the controller using neural networks has better performance.
Author (EI)
Control Systems Design; Flight Envelopes; Linearization; Multivariable Control; Rotors; Turbojet Engines; Velocity

19960049119
Robust speed control of induction motors using position and current measurements
Khalil, Hassan K., Michigan State Univ, USA; Strangas, Elias G.; IEEE Transactions on Automatic Control; August 1996; ISSN 0018-9286; vol. 41, no. 8, pp. 1216-1220; In English; In English; Copyright; Avail: Issuing Activity

A nonlinear robust output feedback control is designed for a sixth-order model of an induction motor. The control uses only measurement of the rotor position and stator currents. It contains two observers, a second-order observer to estimate the rotor flux from the stator current and a third-order high-gain observer to estimate the rotor speed and acceleration from its position. The control is robust to uncertainties in the rotor and stator resistances, and a bounded time-varying load torque. It guarantees that the speed tracking error can be made arbitrarily small by choice of certain design parameters. Moreover, when the speed reference and load torque are constant, it ensures asymptotic regulation. Simulation results agree well with the analysis.
Author (EI)
Control Equipment; Feedback Control; High Gain; Loads (Forces); Nonlinear Systems; Robustness (Mathematics); Rotors; Speed Control; Stators

19960049373
Development and flight testing of quantitative feedback theory pitch rate stability augmentation system
Fontenrose, Paul L., North Carolina State Univ, USA; Hall, Charles E., Jr.; Journal of Guidance, Control, and Dynamics; September 1996; ISSN 0731-5090; vol. 19, no. 5, pp. 1109-1115; In English; In English; Copyright; Avail: Issuing Activity

The design of a quantitative feedback theory control system to improve the flight handling qualities of an unmanned aerial vehicle (UAV) at relaxed stabilities is illustrated. Aircraft flown at low static margins are significantly more efficient than conventional designs, but without stability augmentation they are difficult if not impossible to control. Longitudinal stability augmentation is achieved by using an onboard computer system to calculate control surface deflection based on the sensed pitch rate of the aircraft and pilot elevator commands. The quantitative feedback theory controller was implemented on this computer system to provide acceptable handling characteristics for a large portion of the UAV's flight envelope. The flight tests of the UAV, which resulted in the successful completion of an entire flight at a 2.5% static margin, are also described.
Author (EI)
Control Surfaces; Control Systems Design; Feedback Control; Flight Control; Longitudinal Stability; Pilotless Aircraft

19960037211
Third-order upwind finite element computation of the incompressible Navier-Stokes equations. Part I. Computation of flow around rectangular cylinders
Kondo, Norio, Nihon Univ, Japan; Yamada, Seiji; Computer Methods in Applied Mechanics and Engineering; November 1995; ISSN 0045-7825; vol. 127, no. 1-4, pp. 87-97; In English; Copyright; Avail: Issuing Activity

Aerodynamic behaviors of two-dimensional unsteady flows around rectangular cylinders are numerically investigated by third-order upwind finite element computation of the incompressible Navier-Stokes equations. A turbulence model, such as the two-equation model, is not incorporated in the computational scheme, so that the rectangular cylinders, at depth-breadth ratios from 0.7 to 4, to be considered, are located in a uniform flow. It is found that the numerical results of flows around the rectangular cylinders, obtained by using the third-order upwind finite element scheme, are in good agreement with other computational and experimental results.
Author (EI)
Aerodynamics; Cylindrical Bodies; Finite Element Method; Navier-Stokes Equation; Numerical Analysis; Turbulence Models; Uniform Flow; Unsteady Flow

19960037212
Third-order upwind finite element computation of the incompressible Navier-Stokes equations. Part II. Aerodynamic characteristics of a rectangular cylinder with an angle of attack
Kondo, Norio, Nihon Univ, Japan; Yamada, Seija; Computer Methods in Applied Mechanics and Engineering; November 1995; ISSN 0045-7825; vol. 127, no. 1-4, pp. 99-113; In English; Copyright; Avail: Issuing Activity

Aerodynamic characteristics of rectangular cylinders at depth-breadth ratios of 1 and 2 are investigated in detail by numerical simulation of the incompressible Navier-Stokes equations using a third-order upwind finite element scheme. In the numerical computation, a uniform flow is given at the inlet boundary in a computational region and the rectangular cylinders are inclined toward the approaching flow in the range of angles of attack from 0 deg up to 45 deg. The present solutions for aerodynamic forces and moment by forces of the inclined rectangular cylinders are compared with other numerical results and experimental results.
Author (EI)

Aerodynamics; Angle of Attack; Computerized Simulation; Cylindrical Bodies; Finite Element Method; Navier-Stokes Equation; Uniform Flow

19960037739

Computation of the turbulent flow field around an aerofoil by k- epsilon - gamma model in a non-staggered, C-type single-grid system

Kim, Ki Sup, Korea Research Inst of Ships & Ocean Engineering, Daejon, Korea, USA; Chung, Myung Kyoon; Communications in Numerical Methods in Engineering; November 1995; ISSN 0748-8025; vol. 11, no. 11, pp. 873-886; In English; Copyright; Avail: Issuing Activity

The whole turbulent flow field around a two-dimensional aerofoil is solved with a consistent numerical method on a single-grid system and with an intermittency implemented two-equation model, namely the k- epsilon - gamma turbulence model in elliptic form. In order to solve the numerical instability problem arising from the branch-cut in C-type grids using the non-staggered finite-volume method, a new numerical technique is proposed to guarantee the correct velocity-pressure coupling along the branch-cut. The computational results are compared with those by the standard k-epsilon model and experimental data. This study demonstrates the relative simplicity of the present C-type single grid system, and the capability is assessed of the k- epsilon - gamma equations for predicting turbulent flows consisting of both wall-free and wall-bounded regions.

Author (EI)

Airfoils; Mathematical Models; Numerical Analysis; Turbulence; Turbulent Flow

19960038831

Hybrid asymptotic-numerical method for low Reynolds number flows past a cylindrical body

Kropinski, M. C. A., New York Univ, USA; Ward, Michael J.; Keller, Joseph B.; SIAM Journal on Applied Mathematics; December 1995; ISSN 0036-1399; vol. 55, no. 6, pp. 1484-1510; In English; Copyright; Avail: Issuing Activity

The classical problem of slow, steady, two-dimensional flow of a viscous incompressible fluid around an infinitely long straight cylinder is considered. The cylinder cross section is symmetric about the direction of the oncoming stream but otherwise is arbitrary. For low Reynolds number, the well-known singular perturbation analysis for this problem shows that the asymptotic expansions of the drag coefficient and of the flow field start with infinite logarithmic series. We show that the entire infinite logarithmic expansions of the flow field and of the drag coefficient are contained in the solution to a certain related problem that does not involve the cross-sectional shape of the cylinder. The solution to this related problem is computed numerically using a straightforward finite-difference scheme. The drag coefficient for a cylinder of a specific cross-sectional shape, which is asymptotically correct to within all logarithmic terms, is given in terms of a single shape-dependent constant that is determined by the solution to a canonical Stokes flow problem. The resulting hybrid asymptotic-numerical method is illustrated for cylinders of various cross-sectional shapes. For a circular cylinder, our results for the drag coefficient are compared with experimental results, with the explicit three-term asymptotic theory of Kaplun, and with numerical results computed from the full problem. A similar hybrid approach is used to sum infinite logarithmic expansions for a generalized version of Lagerstrom's ordinary differential equation model of slow viscous flow.

Author (EI)

Aerodynamic Coefficients; Aerodynamic Drag; Cylindrical Bodies; Drag; Finite Difference Theory; Flow Distribution; Incompressible Fluids; Numerical Analysis; Reynolds Number; Stokes Flow; Two Dimensional Flow; Viscous Flow

16
PHYSICS

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

19960035627 Naval Postgraduate School, Dept. of Physics., Monterey, CA USA

Directed energy effects on the flight path of a spinning ballistic projectile

Capen, George S., Naval Postgraduate School, USA; Jun. 01, 1995; 95p; In English

Contract(s)/Grant(s): NR Proj. ILIR

Report No.(s): AD-A303096; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

This thesis will examine the equations of motion for a spinning ballistic projectile. The goal of such an examination is to determine the possible mechanisms by which a directed energy weapon may induce sufficient instability as to significantly alter the projectile's flight path. A ballistic projectile is generally launched with a 'fire and forget' philosophy. The desired impact point is determined before firing. It may be possible to alter the projectile in such a way that it fails to follow the desired trajectory thereby missing the intended target. Several variables appear to be worthy of investigation to assess their contribution to a required instability or range reduction. Skin friction drag may be increased from surface roughness generated by a pulsed energy source. The results that this thesis will examine include: impulse generated by the laser interaction, additional Magnus effects and aerodynamic drag. Moment induced instability may also result from these

in the form of a Magnus moment or drag torque. Increasing the drag force appears to be the most promising theoretical solution to defeating an incoming spinning ballistic projectile.
DTIC
Equations of Motion; Projectiles; Electromagnetic Interactions; Flight Paths; Aerodynamic Drag

19960037847
Distinction of damping regions of rotor systems modal vibrations
Shitsze, YA.; Prikladnaya Mekhanika; May 1994; ISSN 0032-8243; vol. 30, no. 5, pp. 76-80; In Russian; Copyright; Avail: Issuing Activity

General method for distinction of stability regions is applied to the problem of oscillations of multimass rotor systems taking into account both the external and internal damping of oscillations. The stability problem was reduced to the analysis of parameters characterizing the inertial properties of rigidity and to the damping at the upper and lower supports of the multimass rotor system. The limits of stability regions have been analyzed in details depending on the variations of the supports parameters. The range of the parameters values, over which practically needed reserve of the system stability is realized, was determined.
Author (EI)
Oscillations; Rotors; Vibration Mode

19960038075
Estimation of non-linear stiffness parameters of rolling element bearings from random response of rotor-bearing systems
Tiwari, R., Indian Inst of Technology, India; Vyas, N. S.; Journal of Sound and Vibration; October 26 1995; ISSN 0022-460X; vol. 187, no. 2, pp. 229-239; In English; Copyright; Avail: Issuing Activity

A technique for estimation of non-linear stiffness parameters of rolling element bearings in rotor systems, based on the analysis of the random response signals picked up from the bearing caps, is developed. The rotor-bearing system is modelled through the Fokker-Planck equation and the vibrations, resulting due to random imperfections of the bearing surfaces and assembly, are processed through a curve fitting algorithm to obtain the necessary bearing stiffness parameters. The technique has an advantage over existing ones in that it does not require an estimate of the excitation forces and works directly on the measured response signals of the system. The algorithm is illustrated for a laboratory rotor-bearing test rig and the results are compared with those obtained through an existing analytical model.
Author (EI)
Bearings; Fokker-Planck Equation; Mathematical Models; Parameter Identification; Rotors; Signal Analysis; Stiffness; Vibration Mode

19960039552
Degrees of freedom control of a magnetically levitated rotor
Barthod, C., Universite de Savoie L.S.M., France; Lemarquand, G.; IEEE Transactions on Magnetics; November 1995; ISSN 0018-9464; vol. 31, no. 6, pt. 2, pp. 4202-4204; In English; Copyright; Avail: Issuing Activity

Design and realization of a four active and one passive axis magnetic suspension for a vertically high speed rotating rotor are performed. Control is realized directly on the physical degrees of freedom. The mathematical modelling of the dynamic behavior of the rotor enables us to know its speed limitation and to increase it.
Author (EI)
Magnetic Bearings; Magnetic Suspension; Rotors; Suspension Systems (Vehicles)

19960039671
Critical crack assessment procedure for high pressure steam turbine rotors
Sedmak, A., Faculty of Mechanical Engineering, Yugoslavia; Sedmak, S.; Fatigue and Fracture of Engineering Materials & Structures; September 1995; ISSN 8756-758X; vol. 18, no. 9, pp. 923-934; In English; Copyright; Avail: Issuing Activity

A critical crack assessment procedure for high pressure steam turbine rotors is introduced and applied. The processes relating to low-cycle thermal fatigue (LCTF), high-cycle fatigue (HCF) and creep are considered and the critical crack length is determined in accordance with its shape and position, based on a linear elastic fracture mechanics criterion. Taking this critical crack length as the final value, two mechanisms of crack growth are analysed, LCTF and creep, with the aim of defining the initial value of crack length. Alternatively, LCTF and creep are analysed as crack initiation processes with the aim of defining the appropriate time and number of cycles which can be used in relation to crack growth. The worst-case materials data are used in order to obtain a conservative estimation of the critical crack length. The procedure is also applicable, directly or modified, to other power plant components, e.g. intermediate and low pressure rotors, steamlines and castings.
Author (EI)
Crack Propagation; Cracks; Creep Properties; Fatigue (Materials); Fracture Mechanics; High Pressure; Rotors; Steam Turbines; Thermal Fatigue

19960042351
Vibration analysis of a high speed and light weight rotor system subjected to a pitching or turning motion, I: a rigid rotor system on flexible suspensions
Sakata, M., Takushoku Univ, Japan; Kimura, K.; Okamoto, S.; Oikawa, K.; Journal of Sound and Vibration; August 3 1995; ISSN 0022-460X; vol. 184, no. 5, pp. 871-885; In English; Copyright; Avail: Issuing Activity

High speed rotors in jet engines or turbopumps used in space vehicles are mostly operated at supercritical speeds, and their bearings and housings are usually supported resiliently from the frame in order to reduce critical speeds. However, when the aircraft or the space vehicle turns or responds to disturbances, the rotor may contact the casing due to vibration caused by gyroscopic moment. In this paper, a dynamic analysis is performed of the vibration of a mechanical system subjected to a pitching motion of the frame. The flexibility and the mass of bearing housings are taken into account and the axis of the pitching motion is assumed to be distant from the center of gravity of the rotor. The usefulness of the modelling and the validity of the computational programs are demonstrated by comparison with the experimental results obtained by using a model rotor. The dynamic response of the system in the case of a turning motion is also calculated.
Author (EI)
Center of Gravity; Dynamic Structural Analysis; Jet Engines; Rotors; Suspension Systems (Vehicles); Velocity; Vibration Mode

19960042352
Vibration analysis of a high speed and light weight rotor system subjected to a pitching or turning motion, II: a flexible rotor system on flexible suspensions
Okamoto, S., Hiroshima Univ, Japan; Sakata, M.; Kimura, K.; Ohnabe, H.; Journal of Sound and Vibration; August 3 1995; ISSN 0022-460X; vol. 184, no. 5, pp. 887-906; In English; Copyright; Avail: Issuing Activity

High speed rotors in jet engines or turbopumps used in space vehicles are mostly operated at supercritical speeds, and their bearings and housings are usually supported resiliently from the frame in order to reduce critical speeds. However, when aircraft or space vehicles turn or respond to disturbances, the rotor may be brought into contact with the casing due to the vibration caused by gyroscopic moment or centrifugal force. In this paper, dynamic analyses of a rotor system that comprises flexible suspensions, a flexible shaft, a flexible disk and flexible blades are performed by a finite element method. The rotor is excited by the frame's pitching motion, the axis of which is assumed to be distant from the center of gravity of the rotor. The usefulness of the modeling and the validity of the computational programs are demonstrated by comparison with experimental results obtained by using a model rotor. The dynamic response of the system under a turning motion is also calculated.
Author (EI)
Acoustics; Centrifugal Force; Jet Engines; Pitching Moments; Rotors; Spacecraft; Suspension Systems (Vehicles); Velocity; Vibration Mode

19960043959
Adhesive contact between the surface wave and a rigid strip
Zharii, O. Y., Kiev Univ, Ukraine; Journal of Applied Mechanics, Transactions ASME; June 1995; ISSN 0021-8936; vol. 62, no. 2, pp. 368-372; In English; Copyright; Avail: Issuing Activity

A problem of adhesive contact between the running surface wave and a rigid strip is investigated. The mixed boundary-value problem of elastodynamics is reduced to a singular integral equation for a complex combination of stresses and an exact closed-form solution of it has been derived. Analysis of variation of contact area dimensions, stress distribution and rotor velocity on the frequency of excitation displayed significant differences between the results corresponding to conditions of adhesion and slipping in contact area. The origin of these differences is discussed.
Author (EI)
Boundary Value Problems; Integral Equations; Rayleigh Waves; Rigid Structures; Rotors; Solids; Stresses; Surface Waves

19960046283
On-line identification and location of rotor cracks
Ratan, S., Rutgers Univ, USA; Baruh, H.; Rodriguez, J.; Journal of Sound and Vibration; July 4 1996; ISSN 0022-460X; vol. 194, no. 1, pp. 67-82; In English; Copyright; Avail: Issuing Activity

A new method is proposed to detect and locate a crack in a rotor system. A vector quantity 'residue' is defined using the measured vibration response of the rotor system and the modeled system matrices. It is shown that the non-zero elements of 'residue' correspond to the nodes encompassing the element carrying the crack. Although the derivation of 'residue' is based on the linearized model of the rotor system, the response due to the non-linearity caused by the breathing of the crack is shown to cause only a small amount of contamination. To investigate the robustness of the proposed method a sensitivity analysis is conducted. It is found that the method is capable of detecting a crack of as small a depth as 4% of the shaft diameter. The effects of light damping and the other of finite element discretization on the detection results are also investigated, and are found to be small.
Author (EI)
Cracks; Mathematical Models; Matrix Theory; Rotors; System Identification; Vibration Mode

19960034350 NASA Ames Research Center, Moffett Field, CA USA
In-Flow Acoustic Sensor
Allen, Christopher S., Inventor, Sterling Software, Inc., USA; Dec. 19, 1995; 11p; In English; Also announced as 19940024860
Patent Info.: NASA-Case-ARC-12001-1; US-Patent-5, 477, 506; US-Patent-Appl-SN-149896; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An acoustic sensor for measuring acoustic waves contained in fluid flow flowing over the sensor is introduced. The acoustic sensor reduces any unwanted self-noise associated with the flowing fluid by providing a nose cone having proper aerodynamic properties and by positioning the diaphragm of a microphone of the sensor at a location where any unwanted noise is at a relatively low level. The nose cone has a rounded, blunt or even sharp tip neither of which creates any major disturbances in the flowing fluid which it intercepts.
Official Gazzette of the U.S. Patent and Trademark
Sound Transducers; Acoustic Measurement; Aerodynamic Characteristics; Fluid Flow

19960036378
Note on the aeroacoustic source character of in-duct axial fans
Abom, M., Royal Inst of Technology, Sweden; Boden, H.; Journal of Sound and Vibration; October 5 1995; ISSN 0022-460X; vol. 186, no. 4, pp. 589-598; In English; Copyright; Avail: Issuing Activity

The possibility of using a two-port model to analyze the source character of an in-duct axial fan is investigated. It is found that in the plane wave region the tested fan closely resembles an ideal dipole located at the fan blades. This finding is in agreement with earlier investigations which have been performed. These investigations were based on incomplete source models or direct observations of the variation in acoustic output with different parameters: e.g., fan speed and duct length. One important application of the result is a simplified procedure for determining the two-port source data of axial fans.
Author (EI)
Aerodynamics; Axial Flow; Fans; Mathematical Models; Noise (Sound)

19960040006
Computational aeroacoustics: Issues and methods
Tam, Christopher K. W., Florida State Univ, USA; AIAA Journal; October 1995; ISSN 0001-1452; vol. 33, no. 10, pp. 1788-1796; In English; Copyright; Avail: Issuing Activity

Computational fluid dynamics (CFD) has made tremendous progress especially in aerodynamics and aircraft design over the past 20 years. An obvious question to ask is 'why not use CFD methods to solve aeroacoustics problems?' Most aerodynamics problems are time independent, whereas aeroacoustics problems are, by definition, time dependent. The nature, characteristics, and objectives of aeroacoustics problems are also quite different from the commonly encountered CFD problems. There are computational issues that are unique to aeroacoustics. For these reasons computational aeroacoustics requires somewhat independent thinking and development. The objectives of this paper are twofold. First, issues pertinent to aeroacoustics that may or may not be relevant to computational aerodynamics are discussed. The second objective is to review computational methods developed recently that are designed especially for computational aeroacoustics applications. Some of the computational methods to be reviewed are quite different from traditional CFD methods. They should be of interest to the CFD and fluid dynamics communities.
Author (EI)
Acoustics; Aerodynamics; Computational Fluid Dynamics

19960042350
Experimental and numerical studies of the aeroacoustics of axisymmetric supersonic inlets
Detwiler, K. P., Virginia Polytechnic Inst and State Univ, USA; Yuan, Z.; Ng, W. F.; Journal of Sound and Vibration; August 3 1995; ISSN 0022-460X; vol. 184, no. 5, pp. 853-870; In English; Copyright; Avail: Issuing Activity

A series of experiments were conducted at an outdoor facility to evaluate the aerodynamic and acoustic performance of a supersonic inlet with a modified auxiliary door geometry. A 1/14 scale model of an axisymmetric, mixed-compression, supersonic inlet designed for civil transportation (P-inlet) was used in conjunction with a 10.4 cm (4.1 in) turbofan engine simulator, to test a new auxiliary door geometry designed to reduce engine fan noise radiated to the forward sector. The flow distortion at the fan face was reduced by modifying the auxiliary inlet doors. The new door geometry uses door passages with increased circumferential span to improve the distribution of the flow entering through the doors. to provide a basis for comparison, a baseline inlet with an auxiliary door geometry representative of the original designs was also tested. The results show that the new door geometry is successful in reducing circumferential distortion of the flow Mach number near the fan face by 30% compared to the baseline configuration. In addition, far field radiation of the blade passing frequency tone and overall noise is reduced by an average of 4dB (SPL) in the forward sector (0 deg to 110 deg from the inlet axis). A 3-D, viscous numerical simulation of the baseline door configuration reveals a large region of flow separation downstream of the auxiliary door. This flow separation leads to a significant increase in circumferential distortion at the fan face.
Author (EI)
Acoustics; Aerodynamics; Intake Systems; Mach Number; Simulators; Supersonic Inlets; Turbofan Engines

19960042501 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
Prediction and analysis of the noise emitted by a main helicopter rotor in case of blade-vortex interactions *Prevision et analyse du bruit emis par un rotor principal d'helicoptere en presence d'interactions pale-tourbillon*
Spiegel, Pierre, Office National d'Etudes et de Recherches Aerospatiales, France; 1996; 208p; In French; No Copyright;

Avail: CASI; A10, Hardcopy; A03, Microfiche

The focus of this thesis is the prediction of the noise emitted by a helicopter's articulated main rotor, especially in the case of blade vortex interactions (BVI), as BVI impulsive noise constitutes an important annoyance near heliports. The time domain formulation used for the acoustic calculation, based on the Ffowcs Williams and Hawkings equation and expressed in a frame fixed to the helicopter, is explained in detail and with physical elaboration. It provides the thickness and loading noise terms used in the computational program PARIS, which is particularly well suited to BVI noise prediction. The BVI phenomenon is first analyzed in simple theoretical cases in order to reveal the noise generation mechanisms and to quantify the acoustic influence of the main parameters. Then a new, so-called 'iso-event,' spanwise interpolation technique, which reduces the computational time and memory needed, is presented, as well as a method for locating the noisiest interactions. The BVI noise predictions obtained with a chain of several programs, the last of them being PARIS, are validated by comparison to anechoic wind tunnel test data, for a conventional rotor and for a rotor with soft blades under higher harmonic control.

Author

Helicopters; Rotary Wings; Blade Slap Noise; Blade-Vortex Interaction; Acoustic Properties; Noise Prediction (Aircraft); Aircraft Noise; Applications Programs (Computers)

19960042711 Lockheed Aeronautical Systems Co., Marietta, GA USA

Aircraft Noise Prediction Program (ANOPP) Fan Noise Prediction for Small Engines

Hough, Joe W., Allied-Signal Corp., USA; Weir, Donald S., Allied-Signal Corp., USA; Apr. 1996; 186p; In English

Contract(s)/Grant(s): NAS1-20102; RTOP 538-03-11-01

Report No.(s): NASA-CR-198300; NAS 1.26-198300; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The Fan Noise Module of ANOPP is used to predict the broadband noise and pure tones for axial flow compressors or fans. The module, based on the method developed by M. F. Heidmann, uses empirical functions to predict fan noise spectra as a function of frequency and polar directivity. Previous studies have determined the need to modify the module to better correlate measurements of fan noise from engines in the 3000- to 6000-pound thrust class. Additional measurements made by AlliedSignal have confirmed the need to revise the ANOPP fan noise method for smaller engines. This report describes the revisions to the fan noise method which have been verified with measured data from three separate AlliedSignal fan engines. Comparisons of the revised prediction show a significant improvement in overall and spectral noise predictions.

Author

Noise Prediction (Aircraft); Jet Engines; Noise Spectra

19960043054 NASA Ames Research Center, Moffett Field, CA, USA

Unstructured adaptive mesh computations of rotorcraft high-speed impulsive noise

Strawn, Roger C., NASA Ames Research Cent, USA; Biswas, Rupak, NASA Ames Research Center, USA; Garceau, Michael, NASA Ames Research Center, USA; Journal of Aircraft; July 1995; ISSN 0021-8669; vol. 32, no. 4, pp. 754-760; In English; Copyright; Avail: Issuing Activity

A new method is developed for modeling helicopter high-speed impulsive (HSI) noise. The aerodynamics and acoustics near the rotor blade tip are computed by solving the Euler equations on an unstructured grid. A stationary Kirchhoff surface integral is then used to propagate these acoustic signals to the far field. The near-field Euler solver uses a solution-adaptive grid scheme to improve the resolution of the acoustic signal. Grid points are locally added and/or deleted from the mesh at each adaptive step. An important part of this procedure is the choice of an appropriate error indicator. The error indicator is computed from the flowfield solution and determines the regions for mesh coarsening and refinement. Computed results for HSI noise compare favorably with experimental data for three different hovering rotor cases.

Author (EI)

Acoustics; Aerodynamics; Blade Tips; Computational Grids; Differential Equations; High Speed; Mathematical Models; Near Fields; Noise (Sound); Rotary Wing Aircraft; Rotary Wings; Signal Transmission; Sound Waves

19960043891

Acoustics of a moving source in a moving medium with application to propeller noise

Wells, V. L., Arizona State Univ, USA; Han, A. Y.; Journal of Sound and Vibration; July 27 1995; ISSN 0022-460X; vol. 184, no. 4, pp. 651-663; In English; Copyright; Avail: Issuing Activity

In this paper the development of a convective acoustic analogy equation for the case of a moving source in a moving medium is described and the resulting form is compared to that of Blokhintsev and that of Ffowcs Williams and Hawkings. Computationaal results for a modern propeller with supersonic tips illustrate that both the 'moving observer' and 'moving medium' interpretations of the acoustic analogy lead to the same results, but that computational efficiency may dictate the use of the moving-medium approach. Using similar programming techniques, the moving-medium calculations show a sixfold decrease in CPU time over those obtained using the moving-observer formulation. The computed waveforms from both methods show improvements over previously published results.

Author (EI)

Acoustics; Computer Programming; Noise (Sound); Propellers

19960044391 Advanced Technology Inst. of Commuter-Helicopter Co. Ltd., Japan

Study on Design of Helicopter Blade for Reduction of High-Speed Impulsive Noise

Aoki, Makoto, Advanced Technology Inst. of Commuter-Helicopter Co. Ltd., Japan; Kondo, Natsuki, Advanced Technology Inst. of Commuter-Helicopter Co. Ltd., Japan; Saito, Shigeru, National Aerospace Lab., Japan; Aoyama, Takashi, National Aerospace Lab., Japan; Proceedings of the 13th NAL Symposium on Aircraft Computational Aerodynamics; Jan. 1996, pp. 35-40; In Japanese; Also announced as 19960044384; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The effect of blade tip planform, airfoil, dihedral and anhedral on the high speed impulsive (HSI) noise of a helicopter rotor are investigated. A combined method of computational fluid dynamics (CFD) with an extended Kirchhoff's equation is used to estimate the acoustic pressure of the rotor noise. The method solves Euler equations to obtain the flow field around a rotor blade. The Kirchhoff's equation extended to a moving surface is then used to estimate the acoustic pressure at an observer's position by using the Euler solutions on the Kirchhoff surface in which all the acoustic sources are enclosed. Calculations are performed under the condition of non-lifting hover as the first stage of our study. The calculated results show that the modification of blade tip planform remarkably reduces the absolute value of the negative peak pressure of the rotor noise. It is shown that the blade with the sweepback angle of 40 degrees and the taper ratio of 0.333 from 90 percent rotor radius leads to the reduction of the peak pressure by about 70 percent. The calculated results also show that the modification of blade tip thickness reduces the absolute value of the negative peak pressure of the rotor noise. It s shown that the blade with the thickness varying linearly from 12 percent to 6 percent in the out 10 percent of the radial region leads to a reduction of the peak pressure by about 45 percent. As a result, it is suggested that the original combination of planform and thickness makes it possible to design a quiet rotor.

Author

Aerodynamic Noise; Computational Fluid Dynamics; Rotor Aerodynamics; Sound Pressure; Blade Tips; Kirchhoff Law; Euler Equations of Motion; Noise Reduction; Acoustic Attenuation; Pressure Distribution

19960045293 BBN Systems and Technologies Corp., Canoga Park, CA USA

Comparison of the Performance of Noise Metrics as Predictions of the Annoyance of Stage 2 and Stage 3 Aircraft Overflights

Pearsons, Karl S., BBN Systems and Technologies Corp., USA; Howe, Richard R., BBN Systems and Technologies Corp., USA; Sneddon, Matthew D., BBN Systems and Technologies Corp., USA; Fidell, Sanford, BBN Systems and Technologies Corp., USA; Jul. 1996; 90p; In English

Contract(s)/Grant(s): NAS1-20101; RTOP 538-03-15-01

Report No.(s): NASA-CR-198348; NAS 1.26:198348; BBN-8157; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Thirty audiometrically screened test participants judged the relative annoyance of two comparison (variable level) and thirty-four standard (fixed level) signals in an adaptive paired comparison psychoacoustic study. The signal ensemble included both FAR Part 36 Stage 2 and 3 aircraft overflights, as well as synthesized aircraft noise signatures and other non-aircraft signals. All test signals were presented for judgment as heard indoors, in the presence of continuous background noise, under free-field listening conditions in an anechoic chamber. Analyses of the performance of 30 noise metrics as predictors of these annoyance judgments confirmed that the more complex metrics were generally more accurate and precise predictors than the simpler methods. EPNL was somewhat less accurate and precise as a predictor of the annoyance judgments than a duration-adjusted variant of Zwicker's Loudness Level.

Author

Aircraft Noise; Anechoic Chambers; Judgments; Effective Perceived Noise Levels; Physiological Effects

19960045469 BBN Systems and Technologies Corp., Canoga Park, CA USA

An Assessment of Commuter Aircraft Noise Impact

Fidell, Sanford, BBN Systems and Technologies Corp., USA; Pearsons, Karl S., BBN Systems and Technologies Corp., USA; Silvati, Laura, BBN Systems and Technologies Corp., USA; Sneddon, Matthew, BBN Systems and Technologies Corp., USA; Jun. 1996; 94p; In English

Contract(s)/Grant(s): NAS1-20101; RTOP 538-03-15-01

Report No.(s): NASA-CR-198316; NAS 1.26:198316; BBN-8112; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report examines several approaches to understanding 'the commuter aircraft noise problem.' The commuter aircraft noise problem in the sense addressed in this report is the belief that some aspect(s) of community response to noise produced by commuter aircraft operations may not be fully assessed by conventional environmental noise metrics and methods. The report offers alternate perspectives and approaches for understanding this issue. The report also develops a set of diagnostic screening questions; describes commuter aircraft noise situations at several airports; and makes recommendations for increasing understanding of the practical consequences of greater heterogeneity in the air transport fleet serving larger airports.

Author

Aircraft Noise; Commuter Aircraft; Noise Pollution

19960045625 Research Inst. for Advanced Computer Science, Moffett Field, CA USA

New Computational Methods for the Prediction and Analysis of Helicopter Noise

Strawn, Roger C., Research Inst. for Advanced Computer Science, USA; Oliker, Leonid, Research Inst. for Advanced Computer Science, USA; Biswas, Rupak, Research Inst. for Advanced Computer Science, USA; May 1996; 18p; In English; 2nd; AIAA/CEAS Aeroacoustics Conference, 6-8 May 1996, State College, PA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS2-13721

Report No.(s): NASA-CR-201384; NAS 1.26:201384; AIAA Paper 96-1696; RIACS 96-10; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper describes several new methods to predict and analyze rotorcraft noise. These methods are: 1) a combined computational fluid dynamics and Kirchhoff scheme for far-field noise predictions, 2) parallel computer implementation of the Kirchhoff integrations, 3) audio and visual rendering of the computed acoustic predictions over large far-field regions, and 4) acoustic tracebacks to the Kirchhoff surface to pinpoint the sources of the rotor noise. The paper describes each method and presents sample results for three test cases. The first case consists of in-plane high-speed impulsive noise and the other two cases show idealized parallel and oblique blade-vortex interactions. The computed results show good agreement with available experimental data but convey much more information about the far-field noise propagation. When taken together, these new analysis methods exploit the power of new computer technologies and offer the potential to significantly improve our prediction and understanding of rotorcraft noise.

Author

Computational Fluid Dynamics; Far Fields; Blade-Vortex Interaction; Noise Propagation; Noise Prediction; Helicopters; Aircraft Noise; Acoustic Simulation

19960045628 Naval Postgraduate School, Monterey, CA USA

Integrated Optical Sigma-Delta Modulators

Ying, Stephen J., Naval Postgraduate School, USA; Sep. 1995; 53p; In English

Report No.(s): AD-A304251; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Modern avionics equipment, such as super resolution direction-finding systems, now require resolutions on the order of 20 to 22 bits. Over-sampled analog-to-digital converter architectures offer a means of exchanging resolution in time for that in amplitude and represent an attractive approach to implementing precision converters without the need for complex precision analog circuits. Using over-sampling techniques based on sigma-delta modulation, a convenient tradeoff exists between sampling rate and resolution. One of the major advantages of integrated optics is the capability to efficiently couple wideband signals into the optical domain. Typically, sigma-delta processors require simple and relatively low-precision analog components and thus are well suited to integrated optical implementations. This thesis reviews the current sigma-delta methodology, the advantages of optical integrated circuits and presents the design of a second-order, integrated optical sigma-delta modulator. Simulation results for both a first and second order architecture are presented by evaluating the transfer characteristics numerically. Design parameters such as limit cycles are quantified and explained. Performance issues and future efforts are also considered.

DTIC

Analog to Digital Converters; Avionics; Radio Direction Finders; Signal Processing; Computerized Simulation; Signal to Noise Ratios; Optical Waveguides; Delta Modulation; Architecture (Computers)

19960043791

Characterization of a nitrogen flow within a plasma wind tunnel

Fasoulas, Stefanos, Univ of Stuttgart, Germany; Sleziona, P. Christian; Auweter-Kurtz, Monika; Habiger, Harald A.; Laure, Stefan H.; Schonemann, Anja T.; Journal of Thermophysics and Heat Transfer; July 1995; ISSN 0887-8722; vol. 9, no. 3, pp. 422-431; In English; Copyright; Avail: Issuing Activity

This article presents a comparison of numerical and measured results of a nitrogen high-enthalpy flow. Experimental data at a first cross section are used as initial and boundary conditions for a numerical simulation of the high-enthalpy flow, the results at a second cross section are compared with the numerical solution. The program system employed to examine the flow consists of a Navier-Stokes flowfield solver including models to investigate thermal and chemical non-equilibrium flows. Different measurement techniques were applied to determine the flowfield properties. The measurements made possible the calculation of the local specific enthalpy and mass flux distributions of the plasma plume by basic thermodynamic equations. These mass flux distributions are compared with measurements by mass spectrometry. Special emphasis is also placed on the investigation of the catalytic activity of different materials.

Author (EI)

Boundary Conditions; Enthalpy; Magnetohydrodynamic Flow; Navier-Stokes Equation; Nitrogen; Wind Tunnels

19960037961

A review of the paper double prime A new concept concerning the work of the thermodynamic cycle of air-jet engines double prime

Kosterin, V. A., Kazanskij Gosudarstvennyj Tekhnicheskij Univ, Russia; Izvestiya VUZ: Aviatsionnaya Tekhnika; October 1994; ISSN 0579-2975, no. 4er, pp. 105-107; In Russian;

Copyright; Avail: Issuing Activity

The author of the review points out that many points of the paper being reviewed are correct. For instance, according to the existing theory of air-jet engines, it is assumed that the engine is immovable, and an air flow of unlimited sizes collides with the engine. In reality, the engine as though hits immovable air of the Earth atmosphere. But, according to the author of the review, several assertions of the author of the paper are not correct and should be refined. Several expressions have been presented to prove these assertions.

Author (EI)

Air Jets; Jet Engines; Technical Writing; Thermodynamic Cycles; Thermodynamics

19960037962

A commentary on the paper double prime A new concept concerning the work of the thermodynamic cycle of air-jet engines double prime

Tarasov, F. F., Ufimskij Gosudarstvennyj Aviatsionnyj Tekhnicheskij Univ, Russia; Izvestiya VUZ: Aviatsionnaya Tekhnika; October 1994; ISSN 0579-2975, no. 4er, pp. 108; In Russian; Copyright; Avail: Issuing Activity

According to the author of the commentary, this paper mentioned does not refute the traditional theory of air jet engines. The author of the commentary points out that many points of a double prime new double prime theory outlined in the paper have been undeveloped and, in many cases, are incorrect. It is underscored that it is incorrect to consider the existing theory of air-jet engines obsolete and unsound. It does not mean that this theory can't be refined and extended.

Author (EI)

Air Jets; Jet Engines; Technical Writing; Thermodynamic Cycles; Thermodynamics

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.

19960037126

Using labVIEW to provide a rapid prototyping environment for the teaching of avionics systems

Reeves-Hardcastle, P., Loughborough Univ, UK; Parish, D. J.; IEEE Aerospace and Electronic Systems Magazine; December 1995; ISSN 0885-8985; vol. 10, no. 12, pp. 9-12; In English; Copyright; Avail: Issuing Activity

This paper describes a simulation environment which has been used to teach the fundamental principles of Avionics Systems to students of Systems Engineering at Loughborough University of Technology. A versatile model of a Radar System is detailed as an example and its attributes from a teaching perspective are highlighted. The generic nature of the environment is also described, as is its position within the systems life cycle.

Author (EI)

Avionics; Education; Life (Durability); Position Indicators; Radar Equipment; Systems Engineering; Tools

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Author

Aerospace Engineering; Information Dissemination; Aerospace Industry; Information Systems; Information Transfer; Aerospace Technology Transfer; Propulsion; Aircraft Engines

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Author
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