NASA SP-7037 (338)
December 20, 1996

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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The NASA CASI price code table, addresses of organizations, and document availability information are located at the back of this issue.

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

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Two indexes are available. You may use the **Find** command under the **Tools** menu while viewing the PDF file for direct match searching on any text string. You may also view the indexes provided, for searching on *NASA Thesaurus* subject terms and author names.

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Author Index **PA–1**

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Select **Appendix** for important information about NASA Scientific and Technical Information (STI) Program Office products and services, including registration with the NASA Center for Aero-Space 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

DOCUMENT ID NUMBER →	**19960021053** 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)*	

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 338)

DECEMBER 20, 1996

01
AERONAUTICS

19960051111 Foreign Broadcast Information Service, Washington, DC USA
FBIS Report: Science and Technology. Central Eurasia: Research at the Central Aerohydrodynamics Institute., Series 1.
Aug. 15, 1996; 178p; In English
Report No.(s): FBIS-UST-96-027; Copyright; Avail: Issuing Activity (Contact FBIS, U.S. Govt. P.O. Box 2604, Wash., D.C. 20013-2604; Non-U.S. Govt. 5285 Port Royal Rd., Springfield, VA. 22161), Hardcopy, Microfiche

Translated articles cover the following topics: structure of distributed data measuring system for aerodynamic tests; subsystem for determining flow parameter in wind tunnel; subsystem for weight tests of models; subsystem for studying pressure distribution; devices for metrologic support of distributed data measurement system; software for distributed data measuring system; magneto-anisotropic acceleration transducers; reduction of influence of combs in pressure detectors on measured parameters of flow at output from aerodynamic model channel; transducer for measuring angle of rotation of shaft with magnetic disk; mathematical model and algorithm for planning data registry in heat-resistance tests; identification of individuals from set of criteria; binary counters with controllable and random counting sequence; designing of infrared heater for heat-resistance tests of flightcraft; research on thermal conductivity coefficient of material of ShVP-350 chamotte fibrous plates; high-temperature infrared heaters; heat exchange in neighborhood of critical point of flightcraft hyperbolic nose; and numerical research on interaction between a supersonic axisymmetric jet and slanting plane barrier.
CASI
Russian Federation; Research and Development; Technologies; Aerodynamics; Hydrodynamics; Flow Measurement; Pressure Measurement

19960051304 Israeli Air Force, Beer-Sheva, Israel
Residual Life Analysis and a Novel Repair Method for Cracks in F-16 Center Fuselage Bulkhead
Jiny, S., Israeli Air Force, Israel; Davidi, G., Israeli Air Force, Israel; Makevet, E., Israeli Air Force, Israel; Schur, D., Israeli Air Force, Israel; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 589-608; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Numerous cracks were detected in a critical panel in the center fuselage bulkhead on Israeli Air Force (IAF) F-16 aircraft, at an early stage of their service life. The immediate problem faced by the IAF was to develop an effective repair for cracked panels, and to determine the criteria for the continued safe operation of aircraft exceeding the repair limits. A residual life analysis was conducted for the most advanced state of damage, in which the crack had severed the ligament between the critical hole and an adjacent cutout in the panel. The results of the analysis served to define an inspection program for the applicable aircraft. For the majority of the fleet, a unique repair method was developed by the IAF. This involved a crescent shaped cutout removing the crack from the critical hole, followed by cold-working the entire circumference of the resultant geometry. A special tool kit was designed and manufactured to facilitate fleet-wide repair of cracked panels. The effectiveness of the crescent repair method was verified by local finite element analysis and by comparative fatigue testing of coupons. The crescent repair was shown to provide a far superior structural configuration than the original configuration in terms of fatigue life. by implementing this innovative repair method the panel cracking problem was eliminated.
Author
Aircraft Maintenance; Cold Working; F-16 Aircraft; Fatigue Tests; Holes (Mechanics); Finite Element Method; Fuselages; Crack Propagation

19960051309 Battelle Columbus Labs., OH USA
Ultrasonic Techniques for Repair of Aircraft Structures with Bonded Composite Patches
Smith, S. H., Battelle Columbus Labs., USA; Senapati, N., Battelle Columbus Labs., USA; Francini, R. B., Battelle Columbus Labs., USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 655-671; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper describes a research and development project to demonstrate a novel ultrasonic process for the field application of boron/epoxy (B/Ep) patches for the repair of aircraft structures. The first phase of this project was on process optimization and testing to develop the most practical ultrasonic processing techniques. Accelerated testing and aging behavior of pre-cured B/Ep patches which were ultrasonically bonded to simulated B-52 wing panel assemblies, were preformed by conducting flight-by-flight spectrum loading fatigue tests. The spectrum represented 2340 missions/flights or 30 years of service. The effects of steady state applied temperature and prior exposure of the B/Ep composite patches were evaluated. Representative experimental results of this phase of the project are presented.
Author
Accelerated Life Tests; Boron-Epoxy Composites; Fatigue Tests; Ultrasonics; Wing Panels; Aircraft Maintenance; Curing; Crack Initiation

19960052267 PKCR, Inc., Seattle, WA USA
High-Lift Systems on Commercial Subsonic Airliners
Rudolph, Peter K. C., PKCR, Inc., USA; Sep. 1996; 166p; In English
Contract(s)/Grant(s): A46374D(LAS)
Report No.(s): NASA-CR-4746; NAS 1.26:4746; A-962169; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The early breed of slow commercial airliners did not require high-lift systems because their wing loadings were low and their speed ratios between cruise and low speed (takeoff and landing) were about 2:1. However, even in those days the benefit of high-lift devices was recognized. Simple trailing-edge flaps were in use, not so much to reduce landing speeds, but to provide better glide-slope control without sideslipping the airplane and to improve pilot vision over the nose by reducing attitude during low-speed flight. As commercial-airplane cruise speeds increased with the development of more powerful engines, wing loadings increased and a real need for high-lift devices emerged to keep takeoff and landing speeds within reasonable limits. The high-lift devices of that era were generally trailing-edge flaps. When jet engines matured sufficiently in military service and were introduced commercially, airplane speed capability had to be increased to best take advantage of jet engine characteristics. This speed increase was accomplished by introducing the wing sweep and by further increasing wing loading. Whereas increased wing loading called for higher lift coefficients at low speeds, wing sweep actually decreased wing lift at low speeds. Takeoff and landing speeds increased on early jet airplanes, and, as a consequence, runways worldwide had to be lengthened. There are economical limits to the length of runways; there are safety limits to takeoff and landing speeds; and there are speed limits for tires. So, in order to hold takeoff and landing speeds within reasonable limits, more powerful high-lift devices were required. Wing trailing-edge devices evolved from plain flaps to Fowler flaps with single, double, and even triple slots. Wing leading edges evolved from fixed leading edges to a simple Krueger flap, and from fixed, slotted leading edges to two- and three-position slats and variable-camber (VC) Krueger flaps. The complexity of high-lift systems probably peaked on the Boeing 747, which has a VC Krueger flap and triple-slotted, inboard and outboard trailing-edge flaps. Since then, the tendency in high-lift system development has been to achieve high levels of lift with simpler devices in order to reduce fleet acquisition and maintenance costs. The intent of this paper is to: (1) review available high-lift devices, their functions, and design criteria; (2) appraise high-lift systems presently in service on commercial air liners; (3) present personal study results on high-lift systems; (4) develop a weight and cost model for high-lift systems; and (5) discuss the development tendencies of future high-lift systems.
Author
Aerodynamic Coefficients; Attitude (Inclination); Cost Analysis; Design Analysis; Leading Edge Flaps; Leading Edges; Lift Devices; Trailing Edge Flaps; Trailing Edges; Wing Loading; Wing Camber; Wing Slots; Commercial Aircraft

19960052296 NASA Lewis Research Center, Cleveland, OH USA
HBCU's Research Conference Agenda and Abstracts
Dutta, Sunil, Compiler, NASA Lewis Research Center, USA; HBCUs Research Conference Agenda and Abstracts; Jul. 1996; 72p; In English, 10-11 Apr. 1996, Cleveland, OH, USA; Sponsored by NASA Lewis Research Center, USA; Also announced as 19960052297 through 19960052332
Report No.(s): NASA-CP-10189; NAS 1.55:10189; E-10182; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche; Abstracts Only; Abstracts Only

The purpose of this Historically Black Colleges and Universities (HBCU's) Research Conference was to provide an opportunity for principal investigators and their students to present research progress reports. The abstracts included in this report indicate the range and quality of research topics such as aeropropulsion, space propulsion, space power, fluid dynamics, designs, structures and materials being funded through grants from Lewis Research Center to HBCU's. The conference generated extensive networking between students, principal investigators, Lewis technical monitors, and other Lewis researchers.
Author
Conferences; Aircraft Engines; Fluid Dynamics; Propulsion

19960053846 Diffracto Ltd., Windsor, Ontario Canada
Development of a D SIGHT Aircraft Inspection System, Phase 2 ***Final Report***
Karpala, F., Diffracto Ltd., Canada; Hageniers, O. L., Diffracto Ltd., Canada; Mar. 1996; 63p; In English
Report No.(s): AD-A306926; DOT/FAA/AR-95/15; No

Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report presents Phase 2 results of an international Project Arrangement between the Federal Aviation Administration and Transport Canada Aviation for the development and testing of a nondestructive inspection system for aircraft corrosion detection in fuselage lap splice joints. The process is based on D SIGHT, an optical technique developed by Diffracto Limited. This report describes the further development of the D SIGHT system hardware and software based upon results obtained from prototype testing during Phase 1. A better understanding of the corrosion process and the sensitivity of D SIGHT has been established by imaging numerous corroded specimens containing both artificially accelerated and naturally occurring corrosion in lap splices. A computer model was developed and validated which can accurately predict D SIGHT signatures for a variety of lap splice geometries. Finally, the new system was field tested at airline maintenance facilities to obtain user feedback.

DTIC

Computerized Simulation; Aircraft Maintenance; Nondestructive Tests; Imaging Techniques; Inspection; Corrosion; Airline Operations; Computer Programs

19960054052 Foreign Broadcast Information Service, Washington, DC USA

FBIS Report: Science and Technology. Central Eurasia: Research at the Central Aerohydrodynamics Inst. (TsAGI) 1995, Series 2

Trudy Tsentralnogo Aerogidrodinamicheskogo Inst. IM. Prof. N. Ye. Zhukovskogo; Aug. 19, 1996; 190p; Transl. into ENGLISH from various Central Eurasian articles; In English

Report No.(s): FBIS-UST-96-028; Copyright; Avail: Issuing Activity (FBIS, PO Box 2604, Washington, DC 20013-2604), Hardcopy, Microfiche

Translated articles cover the following topics: optimum forms of waveriders with quasicone on lower surface; method for generalizing heat transfer data in uniformly heated horizontal pipe with different heat transfer agent flow regimes; hydrodynamics of self-similar fluid flows with internal free boundaries; jet streamline flow around contour with water intake channel having variable curvature of entry edges; streamline flow around plane slit water intake with rounded entry edge; influence of turn sector on operating radius of hypersonic aircraft; comparative analysis of principal aerodynamic characteristics of heavy aircraft and its model; calculation of vortical currents within framework of nonstationary euler model; use of nonstationary euler equations in calculating detached axisymmetric streamline flow around system of two bodies within framework of nonstationary euler equations; and research on streamline flow around nose parts of bodies of revolution with Riabouchinsky generatrix.

Derived from text

Research and Development; Aerodynamic Characteristics; Fluid Flow; Hypersonic Aircraft; Laminar Flow; Technologies; Radii; Heat Transfer

19960054374 Army Aviation Systems Command, Moffett Field, CA USA

A Comparison of Lifting-Line and CFD Methods with Flight Test Data from a Research Puma Helicopter

Bousman, William G., Army Aviation Systems Command, USA; Young, Colin, Defence Research Agency, Farnborough, UK; Toulmay, Francois, Eurocopter France, France; Gilbert, Neil E., Aeronautical Research Labs., Australia; Strawn, Roger C., Army Aviation Systems Command, USA; Miller, Judith V., Defence Research Agency, Farnborough, UK; Maier, Thomas H., Army Aviation Systems Command, USA; Costes, Michel, Office National d'Etudes et de Recherches Aerospatiales, France; Beaumier, Philippe, Office National d'Etudes et de Recherches Aerospatiales, France; Oct. 1996; 352p; In English

Contract(s)/Grant(s): RTOP 505-59-87

Report No.(s): NASA-TM-110421; NAS 1.15: 110421; A-962753; USAATCOM TR-96-A-008; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

Four lifting-line methods were compared with flight test data from a research Puma helicopter and the accuracy assessed over a wide range of flight speeds. Hybrid Computational Fluid Dynamics (CFD) methods were also examined for two high-speed conditions. A parallel analytical effort was performed with the lifting-line methods to assess the effects of modeling assumptions and this provided insight into the adequacy of these methods for load predictions.

Author

Computational Fluid Dynamics; Flight Tests; Data Acquisition

19960055049 NASA Langley Research Center, Hampton, VA USA

The 1995 NASA High-Speed Research Program Sonic Boom Workshop, Volume 1

Baize, Daniel G., Editor, NASA Langley Research Center, USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop. Volume 1; Jul. 1996; 393p; In English, 12-13 Sep. 1995, Hampton, VA, USA; Also announced as 19960055050 through 19960055067

Contract(s)/Grant(s): RTOP 537-07-21-21

Report No.(s): NASA-CP-3335-Vol-1; L-17572-Vol-1; NAS 1.55:3335-Vol-1; No Copyright; Avail: CASI; A17, Hardcopy; A04, Microfiche

The High-Speed Research Program and NASA Langley Research Center sponsored the NASA High-Speed Research Program Sonic Boom Workshop on September 12-13, 1995. The workshop was designed to bring together NASAs scientists and engineers and their counterparts in industry, other Government agencies, and academia working together in the sonic boom element of NASAs High-Speed Research Pro-

gram. Specific objectives of this workshop were to (1) report the progress and status of research in sonic boom propagation, acceptability, and design; (2) promote and disseminate this technology within the appropriate technical communities; (3) help promote synergy among the scientists working in the Program; and (4) identify technology pacing the development of viable reduced-boom High-Speed Civil Transport concepts. The Workshop included these sessions: Session 1 - Sonic Boom Propagation (Theoretical); Session 2 - Sonic Boom Propagation (Experimental); and Session 3 - Acceptability Studies - Human and Animal.
Author
Aerospace Planes; Sonic Booms; High Speed; Sound Propagation

02
AERODYNAMICS

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

19960051103 National Renewable Energy Lab., Golden, CO USA
Effects of grit roughness and pitch oscillations on the NACA 4415 airfoil
Hoffmann, M. J., Ohio State Univ., USA; Reuss Ramsay, R., Ohio State Univ., USA; Gregorek, G. M., Ohio State Univ., USA; Jul. 1996; 163p; In English
Contract(s)/Grant(s): DE-AC36-83CH-10093; XF-1-11009-3
Report No.(s): NREL/TP-442-7815; DE96-007943; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

A NACA 4415 airfoil model was tested in The Ohio State University Aeronautical and Astronautical Research Laboratory 3 x 5 subsonic wind tunnel under steady state and unsteady conditions. The test defined baseline conditions for steady state angles of attack from -10 deg to +40 deg and examined unsteady behavior by oscillating the model about its pitch axis for three mean angles, three frequencies, and two amplitudes. For all cases, Reynolds numbers of 0.75, 1, 1.25, and 1.5 million were used. In addition, these were repeated after the application of leading edge grit roughness (LEGR) to determine contamination effects on the airfoil performance. Steady state results of the NACA 4415 testing at Reynolds number of 1.25 million showed a baseline maximum lift coefficient of 1.30 at 12.3 deg angle of attack. The application of LEGR reduced the maximum lift coefficient by 20% and increased the 0.0090 minimum drag coefficient value by 62%. The zero lift pitching moment of -0.0967 showed a 13% reduction in magnitude to -0.0842 with LEGR applied. Data were also obtained for two pitch oscillation amplitudes: +/- 5.5 deg and +/- 10 deg. The larger amplitude consistently gave a higher maximum lift coefficient than the smaller amplitude, and both unsteady maximum lift coefficients were greater than the steady state values. Stall is delayed on the airfoil while the angle of attack is increasing, thereby causing an increase in maximum lift coefficient. A hysteresis behavior was exhibited for all the unsteady test cases. The hysteresis loops were larger for the higher reduced frequencies and for the larger amplitude oscillations. As in the steady case, the effect of LEGR in the unsteady case was to reduce the lift coefficient at high angles of attack. In addition, with LEGR, the hysteresis behavior persisted into lower angles of attack than for the clean case.
DOE
Airfoils; Subsonic Wind Tunnels; Angle of Attack; Steady State; Pitching Moments; Reynolds Number; Oscillations; Aerodynamic Coefficients; Aerodynamic Drag

19960051135 National Renewable Energy Lab., Golden, CO USA
Effects of grit roughness and pitch oscillations on the S813 airfoil
Ramsay, R. R., Ohio State Univ., USA; Gregorek, G. M., Ohio State Univ., USA; Jul. 1996; 162p; In English
Contract(s)/Grant(s): DE-AC36-83CH-10093
Report No.(s): NREL/TP-442-8168; DE96-007945; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Horizontal axis wind turbine rotors experience unsteady aerodynamics due to wind shear when the rotor is yawed, when rotor blades pass through the support tower wake, and when the wind is gusting. An understanding of this unsteady behavior is necessary to assist in the calculation of rotor performance and loads. The rotors also experience performance degradation due to surface roughness. These surface irregularities are due to the accumulation of insect debris, ice, and/or the aging process. Wind tunnel studies that examine both the steady and unsteady behavior of airfoils can help define pertinent flow phenomena, and the resultant data can also be used to validate analytical computer codes. An S813 airfoil model was tested in The Ohio State University Aeronautical and Astronautical Research Laboratory (OSU/AARL) 3 X 5 subsonic wind tunnel (3 X 5) under steady flow with both stationary model conditions, and pitch oscillations. to study the extent of performance loss due to surface roughness, a standard grit pattern, leading edge grit roughness (LEGR), was used to simulate leading edge contamination. After baseline cases were completed, the LEGR was applied for both steady state and model pitch oscillation cases. The Reynolds numbers for steady state conditions were 0.75, 1, 1.25 and 1.4 million, while the angle of attack ranged from -20 deg to +40 deg. With the model undergoing pitch oscillation, data were acquired at Reynolds numbers of 0.75, 1, 1.25, and 1.4 million, at frequencies of 0. 6, 1.2, and 1. 8 Hz. Two sine wave forcing functions +/- 5.5 deg and +/- 10 deg were used; at mean angles of attack of 8 deg, 14 deg, and 20 deg. For pur-

poses herein, any reference to unsteady conditions means that the model was in pitch oscillation about the quarter chord.
DOE
Wind Turbines; Rotors; Unsteady Aerodynamics; Wind Shear; Loads (Forces); Degradation; Surface Roughness; Angle of Attack

19960052254 Virginia Polytechnic Inst. and State Univ., Dept. of Aerospace and Ocean Engineering., Blacksburg, VA USA
Experimental Evaluation of Pressure-Strain Models in Complex 3-D Turbulent Flow Near a Wing/Body Junction
Oelcmer, M. S., Virginia Polytechnic Inst. and State Univ., USA; Simpson, R. L., Virginia Polytechnic Inst. and State Univ., USA; Feb. 1996; 159p; In English
Contract(s)/Grant(s): N00014-94-1-0092; N00014-90-J-1909
Report No.(s): AD-A307116; VPI-AOE-228; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Comparisons of experimentally-extracted pressure/rate-of-strain values were made to theoretical pressure-strain models for several locations of a wing-body function flow. The experimental pressure/rate-of-strain results were calculated from data obtained with a LDV technique. The data consist of profiles of mean velocity and higher order moments including quadruple products in a two-dimensional turbulent boundary layer (2DTBL), a strongly skewed three-dimensional turbulent boundary layer (3DTBL) in the vicinity of a 3-D separation line; and around the center of the horse-shoe vortex that forms around the wing. Terms in the transport equations for the Reynolds' stresses and the turbulent kinetic energy are also presented here. Several linear and non-linear pressure/rate-of-strain models are tested using the measured quantities as input to the models. The tested models are the Launder-Reece-Rodi, Gibson-Launder, Oberlack-Feters, Fu-Launder-Tselepidakis 2 models), Shih-Lumley/Choi-Lumley, and Speziale-Sarkar-Gataki. The measurements were carried out in the Virginia Tech Boundary Layer Tunnel, at nominal air speed of 27.5 m/s around a NACA 0020 tailed and 3:2 elliptical nosed wing shape. Near-wall correction effects on the theoretical pressure/rate-of-strain models; effect of approximation for the pressure diffusion, the anisotropic dissipation approximation as well as isotropic dissipation approximation on the experimental pressure-strain data are examined. The results are compared to previous Direct Numerical Simulation data qualitatively. Data show that the pressure-diffusion approximation by Lumley is an important term in the V2, UV, and VW stress budgets.
DTIC
Pressure Gradients; Three Dimensional Boundary Layer; Turbulent Boundary Layer; Body-Wing Configurations; Mathematical Models; Kinetic Energy; Two Dimensional Boundary Layer; Vortices; Anisotropy

19960052332 North Carolina Agricultural and Technical State Univ., College of Engineering, Greensboro, NC USA
Numerical Simulations of Wing-Body Junction Flows
Krishnamurthy, R., North Carolina Agricultural and Technical State Univ., USA; Cagle, C., North Carolina Agricultural and Technical State Univ., USA; Chandra, S., North Carolina Agricultural and Technical State Univ., USA; HBCUs Research Conference Agenda and Abstracts; Jul. 1996, pp. 48; In English; Also announced as 19960052296
Report No.(s): Paper-36; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Abstract Only; Abstract Only

The goal of the research project is to contribute to the optimized design of fan bypass systems in advanced turbofan engines such as the Advanced Ducted Propulsors (ADP). The immediate objective is to perform numerical simulation of duct-strut interactions to elucidate the loss mechanisms associated with this configuration that is characteristic of ADP. These numerical simulations would complement an experimental study being undertaken at Purdue University. As the first step in the process, a numerical study of wing-body junction flow is being undertaken as it shares a number of characteristics with the duct-strut interaction flow. The presence of the characteristic horseshoe vortex and the associated secondary flow are the salient features that contribute to making this flow a challenge to predict numerically. The simulations will be performed with the NPARC code on the CRAY Y-MP platform at LeRC. The grids for the simulation have been generated using an algebraic mapping technique with a multisurface algorithm.
Author
Numerical Analysis; Design Analysis; Body-Wing Configurations

19960052425 Pennsylvania State Univ., Dept. of Aerospace Engineering., University Park, PA USA
Computational aeroacoustics and numerical simulation of supersonic jets ***Final Report, Feb. 1993 - Feb. 1996***
Morris, Philip J., Pennsylvania State Univ., USA; Long, Lyle N., Pennsylvania State Univ., USA; Feb. 1996; 35p; In English
Contract(s)/Grant(s): NAG1-1479
Report No.(s): NASA-CR-202239; NAS 1.26:202239; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The research project has been a computational study of computational aeroacoustics algorithms and numerical simulations of the flow and noise of supersonic jets. During this study a new method for the implementation of solid wall boundary conditions for complex geometries in three dimensions has been developed. In addition, a detailed study of the simulation of the flow in and noise from supersonic circular and rectangular jets has been conducted. Extensive comparisons have been made with experimental measurements. A summary of the results of the research program are attached as the main body of this report in the form of two publications.

Also, the report lists the names of the students who were supported by this grant, their degrees, and the titles of their dissertations. In addition, a list of presentations and publications made by the Principal Investigators and the research students is also included.
Author
Aeroacoustics; Supersonic Jet Flow; Computerized Simulation; Boundary Conditions; Computational Fluid Dynamics; Acoustic Scattering; Jet Aircraft Noise

19960053099 Lockheed-Fort Worth Co., Fort Worth, TX USA
Unsteady Transonic Wind Tunnel Test on a Semispan Straked Delta Wing Model Oscillating in Pitch, Part 3:, Selected data points for simulated maneuvers ***Final Report, Mar. 1989 - Dec. 1993***
Cunningham, Atlee M., Jr., Lockheed-Fort Worth Co., USA; denBoer, Ruud G., National Aerospace Lab., Netherlands; Dogger, C. S. G., National Aerospace Lab., Netherlands; Geurts, E. G. M., National Aerospace Lab., Netherlands; Retel, A. P., National Aerospace Lab., Netherlands; Zwaan, R. J., National Aerospace Lab., Netherlands; Nov. 1995; 210p; In English
Contract(s)/Grant(s): AF Proj. 2401
Report No.(s): WL-TR-94-3096; ISBN-3-1176-01421-7641; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

A wind tunnel investigation was conducted in 1992 to investigate the unsteady aerodynamic aspects of transonic high incidence flows over a simple straked wing model. This test was designed to show how low speed vortex type flows evolve into complicated shock vortex interacting flows at transonic speeds. Requirements for this test were based on a low speed test conducted in 1986 on a full span model in the NLR Low Speed Tunnel. The transonic model was a semispan version of the low speed model with some modifications. It was equipped with a three-component semispan balance to measure total wing loads, seven rows of high response pressure transducers to measure unsteady pressures and 15 vertical accelerometers to measure model motion and vibrations. The model was oscillated sinusoidally in pitch at various amplitudes and frequencies for mean model incidences varying from 4 deg. to 480 deg. In addition, maneuver type transient motions of the model were tested with amplitudes of 16 deg. and 30 deg. total rotation at various starting angles. The test was conducted in the NLR HST in the Mach range of 0.225 to 0.90 with some preliminary vapor screen flow visualization data taken at M = 0.6 and 0.9. This part of the report presents selected data points for simulated maneuvers.
Author
Unsteady Aerodynamics; Aeroelasticity; Shock Wave Interaction; Wind Tunnel Tests; Transonic Flow; Vortices; Mach Number; Delta Wings

19960053204 Glasgow Univ., Dept. of Aerospace Engineering, UK
Parallel Implicit Upwind Methods for the Aerodynamics of Aerospace Vehicles
Badcock, K. J., Glasgow Univ., UK; Richards, B. E., Glasgow Univ., UK; Progress and Challenges in CFD Methods and Algorithms; Apr. 1996; 10p; In English; Also announced as 19960053167
Contract(s)/Grant(s): EPSRC/MOD-GR/H47371; DRA/MOD/BAeFRN1C/407; EPSRC-GR/K42264; NTI/65; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Research at the University of Glasgow, based around implicit methods for solving the Euler and Reynolds' averaged Navier-Stokes equations, has targeted advanced computational fluid dynamics (CFD) methods for tackling complex flow fields of interest to aerospace vehicle designers. The requirements for this application are for efficient, high resolution schemes which can be ported to various massively parallel processors (MPP) systems and implemented with a robustness to give fast turn around times at competitive costs. It is recognized that the most demanding topics concern unsteady viscous flows and thus time accuracy and efficiency is pursued as a high priority. This paper reviews the work, ongoing and planned, by the team at Glasgow in code developments embracing future computing environments and including some results not previously published. The example test cases used in the performance and sensitivity studies include transonic flow results on the RAE 2822 airfoil and ONERA M6 wing selected by AGARD. The computing environment to which the codes port include workstations, either used singly or clustered to provide a parallel computing domain, and also integrate distributed memory supercomputers such as CRAY T3D and Intel Hypercube systems. The paper outlines these technologies also.
Author
Computational Fluid Dynamics; Parallel Processing (Computers); Massively Parallel Processors; Navier-Stokes Equation; Unsteady Flow; Viscous Flow; Aerodynamic Loads; Upwind Schemes (Mathematics)

19960053871 Virginia Polytechnic Inst. and State Univ., Dept. of Aerospace and Ocean Engineering., Blacksburg, VA USA
A Wind Tunnel Investigation of a Wing-Tip Trailing Vortex ***Final Report, 1 Jan. 1993 - 18 May 1995***
Engel, Mark A., Virginia Polytechnic Inst. and State Univ., USA; Devenport, William J., Virginia Polytechnic Inst. and State Univ., USA; May 25, 1995; 284p; In English
Contract(s)/Grant(s): N00014-94-1-0744; N00014-94-92-J4087
Report No.(s): AD-A306705; VPI-AOE-218; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

The 3' x 2' Subsonic Wind Tunnel was used to study a wing-tip trailing vortex during its development at the wingtip and at 10 chordlengths downstream. The vortex was found to be well developed by 10 chordlengths. Helium bubble flow-visualization was used to study the development of the vortex in the near-tip regions. Hot wire anemometry was used to study the vortex at 10 chordlengths. Two vortices were found in the tip-flow studies, a primary vortex formed on the suction side surface of the wingtip and a weaker secondary vortex formed on the endcap. The primary vortex lifts from the surface of the wingtip as it proceed along the chord. The vertical displacement is a strong function of angle of attack. The primary vortex is displaced from the endcap towards the wing root at the trailing edge. The spanwise displacement is a strong function of chord Reynolds number. The primary and secondary vortices co-rotate after leaving the wingtip trailing edge. The primary vortex core follows a steady helical path. The radius of the helical path quickly diminishes with downstream distance. The vortex core was extensively analyzed with a four-sensor quad-hot-wire probe at 10 chordlengths behind the model. Flow visualization showed clearly no visible probe interference with the probe stationed inside, outside, and traversing through the vortex core. The vortex core radius, peak tangential velocity, and core circulation increase with increasing angle of attack. The tangential velocity profiles and axial vorticity profiles indicate the development of inner and outer core regions by 5.0 degrees angle of attack. The regions become increasingly differentiated with increasing angle of attack. The inner and outer core regions appear to be associated with the primary and secondary tip vortices, respectively.
DTIC
Wind Tunnel Tests; Wing Tip Vortices; Flow Visualization; Angle of Attack; Velocity Distribution; Vorticity; Trailing Edges

19960054470 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA USA
Transonic Shock Oscillations and Wing Flutter Calculated with an Interactive Boundary Layer Coupling Method
Edwards, John W., National Aeronautics and Space Administration. Langley Research Center, USA; 1996; 18p; In English; 349th; EUROMECH-Colloquium: Simulation of Fluid-Structure Interaction in Aeronautics, 16 - 19 Sep. 1996, Gottingen, Germany
Report No.(s): NASA-TM-110484; NAS 1.15:110484; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A viscous-inviscid interactive coupling method is used for the computation of unsteady transonic flows involving separation and reattachment. A lag-entrainment integral boundary layer method is used with the transonic small disturbance potential equation in the CAP-TSDV (Computational Aeroelasticity Program - Transonic Small Disturbance) code. Efficient and robust computations of steady and unsteady separated flows, including steady separation bubbles and self-excited shock-induced oscillations are presented. The buffet onset boundary for the NACA 0012 airfoil is accurately predicted and shown computationally to be a Hopf bifurcation. Shock-induced oscillations are also presented for the 18 percent circular arc airfoil. The oscillation onset boundaries and frequencies are accurately predicted, as is the experimentally observed hysteresis of the oscillations with Mach number. This latter stability boundary is identified as a jump phenomenon. Transonic wing flutter boundaries are also shown for a thin swept wing and for a typical business jet wing, illustrating viscous effects on flutter and the effect of separation onset on the wing response at flutter. Calculations for both wings show limit cycle oscillations at transonic speeds in the vicinity of minimum flutter speed indices.
Author (AIAA)
Separated Flow; Transonic Flow; Transonic Flutter; Transonic Speed; Unsteady Flow; Viscous Flow; Computational Fluid Dynamics; Coupling; Airfoils; Mach Number; Boundary Layer Separation; Airfoil Oscillations

03
AIR TRANSPORTATION AND SAFETY

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

19960052431 Federal Aviation Administration, Research and Development Div., Atlantic City, NJ USA
The Development of a Flammability Test Method for Aircraft Blankets *Final Report*
Cahill, Patricia, Federal Aviation Administration, USA; Mar. 1996; 37p; In English
Report No.(s): AD-A307201; DOT/FAA/AR-96/15; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flammability testing of aircraft blankets was conducted in order to develop a fire performance test method and performance criteria for blankets supplied to commercial aircraft operators. Aircraft blankets were subjected to vertical Bunsen burner testing, 4-ply vertical testing, full-scale match and cigarette testing, and single- and 4-ply horizontal testing. It was found that the 4-ply horizontal test correlates well with the full-scale match tests, produces consistent test results, and realistically evaluates ease of ignition.
DTIC
Ignition; Flammability; Blankets; Tests; Aircraft Safety

19960052996 Civil Aeromedical Inst., Oklahoma City, OK USA
Fatal General Aviation Accidents Involving Spatial Disorientation: 1976-1992 *Final Report*
Collins, W.E., Civil Aeromedical Inst., USA; Dollar, C.S., Civil Aeromedical Inst., USA; Aug. 1996; 18p; In English

Report No.(s): DOT/FAA/AM-96/21; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Transportation Safety Board (NTSB) analyzes circumstances and data from general aviation accidents and ascribes one or more causes and/or related factors to help explain each accident. The present study was undertaken to (a) provide information regarding the circumstances surrounding fatal general aviation accidents involving spatial disorientation, and (b) define demographic and behavioral characteristics of the spatially-disoriented pilot. Computer retrievals of NTSB brief reports of all spatial disorientation accidents from 1976-92 were analyzed in terms of age and experience of pilots, actions of pilots, night or day, weather, and other conditions. The computer search yielded 1,022 reports of spatial disorientation accidents, which for the 17-year period, resulted in 2,355 fatalities. Related causes and circumstances associated with the accidents were analyzed and categorized. The frequency of spatial disorientation accidents during 1976-92 peaked at 97 fatal accidents in 1977 and generally declined thereafter. The proportion of involved pilots who held an instrument rating about doubled when comparing 1976-83 to 1984-92, over 70% of the accidents were associated with instrument meteorological conditions, and about half of the accidents occurred at night. The proportion of fatal general aviation accidents associated with spatial disorientation has declined significantly since an earlier study (1970-75).

Author

Attitude (Inclination); Aircraft Accidents; Disorientation; Pilot Performance; Space Perception

19960053851 Naval Air Systems Command, Arlington, VA USA

Lightning and Static Electricity

Sep. 28, 1995; 829p; In English, 26-28 Sept. 1995, Williamsburg, VA, USA

Report No.(s): AD-A306836; NAWCADPAX--95-306-PRO; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

This publication reports the proceedings of the 1995 International Aerospace and Ground Conference on lightning and static electricity, which was held at the Williamsburg Cascades Conference Center, Williamsburg, Virginia, on 26-28 September 1995. The conference was sponsored by the Naval Air Systems Command (AIR 4.1.7) and the National Interagency Coordination Group (NICG), which consists of research experts from NASA, DOD, NOAA in concert with the Florida Institute of Technology.

DTIC

Static Electricity; Lightning; Electromagnetic Fields; Aerospace Systems

19960053879 Battelle Columbus Labs., OH USA

Repaired Glass Cockpit W/WS System Safety Report, *1 Sep. 1991 - 29 Feb. 1996*

Olson, Richard J., Battelle Columbus Labs., USA; Feb. 1996; 49p; In English

Contract(s)/Grant(s): F09603-90-D-2217

Report No.(s): AD-A306608; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of repaired glass cockpit Windows/Windshields (W/WS) is being considered by the Air Force. There are risks associated with the use of repaired W/WS that could result in the loss of crew members and/or planes. This report documents the risks and makes recommendations for ways to mitigate the risks.

DTIC

Safety Factors; Systems Engineering; Losses; Glass

19960053896 Galaxy Scientific Corp., Pleasantville, NJ USA

Transport Water Impact and Ditching Performance *Final Report*

Patel, Amit A., Galaxy Scientific Corp., USA; Greenwood, Richard P., Jr., Galaxy Scientific Corp., USA; Mar. 1996; 70p; In English

Contract(s)/Grant(s): DTFA03-89-C-00043

Report No.(s): AD-A307184; DOT/FAA/AR-95/54; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The objective of this program was to (1) review and analyze worldwide transport accident data relative to water impacts and ditching performance, (2) compare the results of this study with current FAA requirements to determine their adequacy/relevancy, and (3) conduct a survey of major worldwide airports to determine their proximity to water. The data were analyzed with respect to the airplanes' structural integrity, breakup patterns, subsystem performance, cabin integrity, and airline procedures that were or could be contributors to injuries and fatalities. A summary of the relevant FAR's was presented to provide background for analysis of the accident data. The methods by which airframe manufacturers may certify their aircrafts' ditching behavior were presented. Because of the infrequency of unplanned water contacts and ditching (planned) occurrences, a case study approach was taken in analyzing the accident data. Eleven worldwide water impact accidents were identified between the years 1959 and 1979. of these, only one was classified as a ditching occurrence. For the years 1980 to the present, three U.S. water related occurrences were identified with no ditching occurrences. In deep water accidents, it was found that when the flight crew had at least some degree of preparedness, trauma-caused injuries were minimized while the majority of fatalities resulted from drowning. When the impact was unexpected, however, the forces on the airplane were generally much higher, resulting in a higher proportion of injuries

and fatalities caused by trauma. In shallow water incidents, usually occurring as a result of runway overruns, drowning was not as common.
DTIC
Airline Operations; Cost Analysis; Deep Water; Structural Failure; Surveys; Airports

19960054011 Federal Aviation Administration, Washington, DC USA
Zero Accidents. A Shared Responsibility: Aviation Safety Action Plan
Feb. 09, 1995; 70p; In English
Report No.(s): AD-A307192; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

On January 9 and 10, 1995, more than 1,000 industry, Government, and union aviation officials met in Washington, D.C. in an unprecedented working session to address aviation safety. A wide range of safety improvements were recommended. Secretary Pena committed to develop an action plan within 30 days that would detail DOT and FAA's response to these issues. This plan clearly reflects the underlying theme of the conference: Aviation safety is a shared responsibility. In a renewed commitment to this shared responsibility, airlines are taking immediate, voluntary action to establish a safety office reporting to the CEO of every airline. In 1996, FAA will publish new regulations that require an independent flight safety department at every airline operating aircraft with more than nine passenger seats; and In March 1995, FAA will publish new regulations that require one level of safety for all air carriers operating aircraft with more than nine passenger seats.
DTIC
Aircraft Safety; Airline Operations; Regulations; Civil Aviation; Commercial Aircraft; Air Transportation

19960054022 Collins Avionics and Missiles Group, Rockwell International Corp., Cedar Rapids, IA USA
Coordinated Parallel Runway Approaches
Koczo, Steve, Collins Avionics and Missiles Group, USA; Oct. 1996; 180p; In English
Contract(s)/Grant(s): NAS1-19704; RTOP 538-04-11-17
Report No.(s): NASA-CR-201611; NAS 1.26:201611; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The current air traffic environment in airport terminal areas experiences substantial delays when weather conditions deteriorate to Instrument Meteorological Conditions (IMC). Expected future increases in air traffic will put additional pressures on the National Airspace System (NAS) and will further compound the high costs associated with airport delays. to address this problem, NASA has embarked on a program to address Terminal Area Productivity (TAP). The goals of the TAP program are to provide increased efficiencies in air traffic during the approach, landing, and surface operations in low-visibility conditions. The ultimate goal is to achieve efficiencies of terminal area flight operations commensurate with Visual Meteorological Conditions (VMC) at current or improved levels of safety.
Author
Air Traffic; Runways; Monitors; Meteorological Instruments

19960054068 Federal Aviation Administration, Atlantic City, NJ USA
Representative Values of Icing-Related Variables Aloft in Freezing Rain and Freezing Drizzle
Jeck, Richard K., Federal Aviation Administration, USA; Mar. 1996; 55p; In English
Report No.(s): AD-A307822; DOT/FAA/AR-TN95/119; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Radiosonde and surface observations in freezing rain (ZR) and freezing drizzle (ZL), and a limited number of aircraft measurements in ZR, have been examined for information on the magnitude and altitude dependence of meteorological variables associated with aircraft icing in these conditions. The variables include temperature aloft, humidity (clouds), and windshear from the radiosondes; surface temperatures, ceiling heights, precipitation type and amount from the surface observations; and temperature, dropsize, rainwater concentration, and icing rate from the instrumented aircraft. These and other data are used here to arrive at tentative maximum and representative values of these variables. to overcome the inadequacy of median volume diameter (MVD) as a measure of dropsize for these large droplet conditions, a convention for reporting the ZR or ZL water concentration over a few coarse dropsize intervals is proposed.
DTIC
Aircraft Icing; Rain; Hail; Meteorological Parameters; Drop Size

19960054492 National Aeronautics and Space Administration, Aerospace Safety Advisory Panel, Washington, DC USA
Aerospace Safety Advisory Panel Annual Report February 1996 ***Annual Report***
Feb. 1996; 80p; In English
Report No.(s): NASA-TM-110474; NAS 1.15:110474; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Aerospace Safety Advisory Panel (ASAP) presents its annual report covering February through December 1995. Findings and recommendations include the areas of the Space Shuttle Program, the International Space Station, Aeronautics, and Other. Information to support these findings is included in this report. NASA's response to last year's annual report is included as an appendix. With regards to the Space Shuttle Program, the panel addresses the potential for safety problems due to organizational changes by increasing its scrutiny of Space Shuttle operations and planning.
Derived from text

Aerospace Safety; International Space Station; Safety Factors; Space Shuttles; Space Transportation System Flights; Flight Safety

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

19960052408 Department of the Navy, Washington, DC USA
Audio Information Apparatus for Providing Position Information
Buchwitz, Guy R., Inventor, Department of the Navy, USA; Muskat, David H., Inventor, Department of the Navy, USA; Feb. 27, 1996; 29p; In English; Supersedes US-Patent-Appl-SN-335560
Patent Info.: US-Patent-Appl-SN-335560; US-Patent-5,495,416
Report No.(s): AD-D018051; No Copyright; Avail: US Patent and Trademark Office, Microfiche

An audio information apparatus for providing position information as to the location of a target comprising a global positioning system receiver affixed to the target for generating a string of fifty ASCII characters representing the latitude and longitude spherical coordinates of the target. The fifty ASCII characters are supplied to a microprocessor which converts a predetermined number of the fifty characters to a plurality of a four bit addresses. The four bit addresses are supplied to a digital voice module which generates an analog audio voice signal in response to the four bit addresses. The analog audio voice signal which represents the location of the global positioning system receiver is supplied to a speaker. T he speaker then broadcast the exact location of the global positioning system receiver. The analog audio voice signal is also supplied to a transmitter for transmission of the signal to a ground station.
DTIC
Auditory Signals; Global Positioning System; Latitude; Microprocessors; Spherical Coordinates

19960052430 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA USA
Methods and Metrics of Voice Communications *Final Report*
Kanki, Barbara G., National Aeronautics and Space Administration. Ames Research Center, USA; Prinzo, O. V., Federal Aviation Administration, USA; Mar. 1996; 275p; In English, 13-14 May 1994, San Antonio, TX, USA; Sponsored by National Aeronautics and Space Administration. Ames Research Center, USA
Contract(s)/Grant(s): DTFA-02-91-C-91089
Report No.(s): AD-A307148; DOT/FAA/AM-96/10; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

This report consists of the proceedings of the Methods and Metrics of Voice Communication Workshop organized by the FAA - Civil Aeromedical Institute, NASA-Ames Research Center, and Armstrong Laboratory - Brooks Air Force Base, held May 13-14, 1994 in San Antonio, Texas. The goal of the meeting was to further our understanding of voice communications in aviation operations by convening a group of language researchers to discuss their experiences with current methods, tools, approaches, etc. The participants came from academic, government and military laboratories, as well as private industry, and their collective expertise included applications conducted in a variety of field, laboratory and simulation environments. This Proceedings is presented in 3 parts: (1) presentations on discourse and acoustic processes, (2) demonstrations of software aids for collecting, coding and analyzing communication data, and (3) an appendix of related supplementary materials and reprints from other publications.
DTIC
Voice Communication; Conferences; Speech; Aircraft Communication

19960052546 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
A Differential GPS Aided INS for Aircraft Landings
Britton, Ryan L., Air Force Inst. of Tech., USA; Dec. 1995; 376p; In English
Report No.(s): AD-A306008; AFIT/GE/ENG/95D-03; No Copyright; Avail: CASI; A17, Hardcopy; A03, Microfiche

The Department of Defense (DOD) and the commercial airline industry are in the process of replacing the instrument landing system (ILS) for aircraft precision approach landings. The use of differential Global Positioning System (DGPS) is thought to be a viable replacement for ILS precision approaches. This thesis explores the integration of an INS, DGPS, Barometric Altimeter, Pseudolite, and Radar Altimeter for a tanker type and a single engine aircraft precision approach. These devices are integrated using an extended Kalman filter (EKF). For the tanker type aircraft federal Aviation Administration (FAA) requirements for a Category-1 and a Category-2 precision approach were met when an INS, DGPS, Barometric Altimeter, and Radar Altimeter were integrated. Category-3 precision approach requirements were met for the single engine type aircraft when the same sensors were integrated.
DTIC
Aircraft Landing; Global Positioning System; Instrument Landing Systems; Inertial Navigation; Landing Instruments

19960052597 Federal Aviation Administration, Technical Center, Atlantic City, NJ USA
Air Ground Data Link VHF Airline Communications and Reporting System (ACARS) Preliminary Test Report
Rehmann, Albert, Federal Aviation Administration, USA;

Mestre, Jose D., Federal Aviation Administration, USA; Feb. 1995; 35p; In English
Report No.(s): AD-A305791; DOT/FAA/CT-TN95/66; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An effort was conducted to determine actual ground to air, and air to ground performance of the Airline Communications and Reporting system (ACARS), Very High Frequency (VHF) Data Link System. Parameters of system throughput, error rates, and availability were measured by tabulating statistics of messages ranging from 2 to 150 bytes in length. The intervals of transmission wer e developed based on anticipated air traffic service (ATS) requirements for tactical air traffic control (ATC) messages and their associated replies. Overall, the average round trip message delay fell in the range of 10 to 20 seconds, with 5 out of approximately 2300 messages lost. Aeronautical Radio Inc. (ARINC) did not endorse these tests, indicating that the Federal Aviation Administration (FAA) tests did not take advantage of the capabilities of the ACARS network which has been optimized for airline use.
DTIC
Air Traffic Control; Data Links; Message Processing; Very High Frequencies; Air Traffic; Communication

19960052729 Naval Postgraduate School, Monterey, CA USA
A Systems Engineering Study of Global-Positioning System Installation onto Army Aircraft
Grekoski, Edward D., Naval Postgraduate School, USA; Dec. 1995; 108p; In English
Report No.(s): AD-A306229; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The purpose of this thesis is to evaluate the systems engineering effort by the Aviation Research and Development Activity (AVRADA), the Airborne Engineering Research Activity (AERA), and support contractor DOSS to install the Trimble Global Positioning System (GPS) receiver onto Army helicopter platforms. This study is an example of a successful systems engineering effort to install a non-developmental item (NDI) onto existing aircraft platforms in response to an urgent requirement created by the deployment of aircraft for Operation Desert Shield.
DTIC
Global Positioning System; Helicopters; Installing; Receivers

19960052843 Naval Surface Warfare Center, Dahlgren, VA USA
Using GPS to Determine an Astronomic-Geodetic Transformation for a Precise Azimuth Reference (PAR)
Hermann, Bruce R., Naval Surface Warfare Center, USA; Cunningham, James, Naval Surface Warfare Center, USA; Dec. 1995; 57p; In English
Report No.(s): AD-A305742; NSWCDD/TR-95/206; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A technique is presented to generate a transformation between the astronomic and geodetic reference frames. The transformation is based on knowing the orientation of a plane in both reference frames. The plane's astronomic orientation is assumed to be known. The geodetic orientation is determined using Global Positioning System (GPS) kinematic relative positioning. For the problem addressed in the report, the plane is a window used to make astronomic observations at Holloman Air Force Base, New Mexico. A precise azimuth reference at an accuracy approaching 0.1 arcsec is derived using observations of the star Polaris. Because the window is inaccessible and cannot be instrumented with GPS antennas, an indirect measurement technique is explored. UPS multipath signals reflected off the window are evaluated as a means whereby the orientation of the window may be determined. The viability of this method is untested. Results from a static positioning test are presented to demonstrate the technique of determining the plane's geodetic orientation. Orientation consistency on the order of 1 arcsec is obtained.
DTIC
Azimuth; Global Positioning System; Reference Systems; Coordinate Transformations; Geodetic Coordinates; Astronomical Coordinates

19960053046 Draper (Charles Stark) Lab., Inc., Cambridge, MA USA
Precision Strike Concepts Exploiting Relative GPS Techniques
Schmidt, George, Draper (Charles Stark) Lab., Inc., USA; Setterlund, Roy, Draper (Charles Stark) Lab., Inc., USA; Jun. 1996; 12p; In English; Also announced as 19960053042; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

Many weapons and weapon carriers will have an avionics suite that includes an integrated inertial navigation system/global positioning system (INS/GPS) set. This means of navigation motivates examination of whether very high accuracy (about 10 ft) circular error probable (CEP) may be obtainable using only this set of weapon avionics operating in a relative GPS mode, rather than in an absolute GPS mode where CEPs of 30 to 40 ft would be expected. This paper will explain how 10 ft accuracy may be achieved and it presents several different weapon system concepts that exploit such a capability to rapidly attack targets.
Author
Avionics; Global Positioning System; Inertial Navigation; Precision Guided Projectiles; Target Acquisition; Target Recognition; Ordnance; Position (Location); Fire Control

19960053047 Department of the Air Force, Eglin AFB, FL USA
Carrier Phase GPS Time, Space, Position Information Demonstration (CAPTIDE)
Costabile, Gregg D., Department of the Air Force, USA;

Fowler, Jesse, Department of the Air Force, USA; Elbert, Timothy, Department of the Air Force, USA; Reiter, David, III, Department of the Air Force, USA; Jun. 1996; 8p; In English; Also announced as 19960053042; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

This paper presents a discussion and results of a flight test to obtain time, space, position information (TSPI) using a carrier phase (or kinematic) global positioning system (GPS). A carrier phase capable GPS receiver was installed on board an F-16 aircraft and flown in conjunction with an inertial navigation system (INS)/differential GPS guided weapon test program. The carrier phase TSPI data was compared to the position solution from existing test range TSPI sources, including: four high dynamic Contraves cinetheodilites operated at 30 frames per second, two FPS-16 radars, the aircraft position system solution, an INS/GPS position measurement pod on board the aircraft, and a post-mission Kalman smoother based software algorithm called 'test data optimal processor'. The carrier phase and and test range solutions were also compared to the INS/differential global positioning system (DPGS) test items. A series of aircraft maneuvers were conducted to collect truth data to compare the carrier phase GPS position with the 'truth' position. This was the first experiment known to the authors which utilized the carrier phase observable in an aircraft environment where high accuracy TSPI was available to evaluate the accuracy of the carrier phase technology.

Author

Aircraft Maneuvers; F-16 Aircraft; Flight Tests; Global Positioning System; Inertial Navigation; Accuracy; Position (Location)

19960053052 Aeronautical Systems Div., Eglin AFB, FL USA

Exploitation of Differential GPS for Guidance Enhancement (EDGE) High Gear Program

Dargan, John L., Aeronautical Systems Div., USA; Howell, Gary, Aeronautical Systems Div., USA; Elbert, Tim, Aeronautical Systems Div., USA; Gaskill, David, Aeronautical Systems Div., USA; Jun. 1996; 12p; In English; Also announced as 19960053042; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

On May 23, 1995, an F-16 dropped a modified GBU-15 incorporating a differentially corrected inertial navigation system/global positioning system (INS/GPS) to successfully attack a vertical target. The GU-15 impacted within 2 meters of the target. The exploitation of differential GPS for guidance enhancement (EDGE) program allows streamlined acquisition and reporting procedures for adding a precision capability to baseline GPS-guided munitions. The EDGE program objective was to demonstrate the navigational accuracy improvement potential of differential GPS (DGPS) for guiding air-to-ground munitions through an end-to-end weapon system implementation of DGPS. Results show that precision navigation accuracy is attainable through DGPS. This paper provides details on the EDGE system implementation and the results from ground, captive, and free-flight tests.

Derived from text

Global Positioning System; Inertial Navigation; Captive Tests; Flight Tests; Precision Guided Projectiles; Bombs (Ordnance)

19960053055 Societe de Fabrication d'Instruments de Mesure, Massy, France

Navigation Without Initialization of an Inertially Guided Bomb ***Navigation sans Initialisation d'une Bombe Guidee Inertiellement***

Paturel, Yves, Societe de Fabrication d'Instruments de Mesure, France; Martin, Eric, Societe de Fabrication d'Instruments de Mesure, France; Audren, Jean-Thierry, Societe de Fabrication d'Instruments de Mesure, France; Technologies for Precision Air Strike Operations in Rapid-Reaction and Localized-Conflict Scenarios; Jun. 1996; 10p; In French; Also announced as 19960053042; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The range of traditional guided bombs is limited to 4 to 6 kilometers depending on the firing conditions. The sophistication of air defences makes bombing missions more and more dangerous for pilots and their aircraft. The use of propelled bombs allows one to increase the range of bombs and therefore to ensure better mission safety. Obtaining accurate precision requires a means of guidance of which the most secure and most independent is inertial guidance. However, such guidance requires initialization of the inertial fusing of the bomb and there fore the supply of data from the aircraft to the bomb (speed, position). This constraint was expensive for earlier models of aircraft for which the numerical data links do not reach the inertial points of the bombs. This article succinctly describes a new technique which allows one to drop a propelled bomb, and guid it with out initializing the inertial mechanism. An analysis of performance features of the process was simulated as well as an analysis of the sensitivity to different error sources. The modifications required for aircraft flight control are described.

Author

Aircraft Control; Data Links; Bombs (Ordnance); Guidance (Motion); Position (Location)

19960053056 Sverdrup Technology, Inc., TEAS Group, Eglin AFB, FL USA

Analysis of Differential Global Positioning System (DGPS) Techniques and GPS Jamming on Precision Guided Munition (PGM) Performance

Mahmood, Sultan, Sverdrup Technology, Inc., USA; Solomon, Joseph, Sverdrup Technology, Inc., USA; James, Rick, Sverdrup Technology, Inc., USA; Lawrence, Danny, Sverdrup Technology, Inc., USA; Technologies for Precision Air Strike Operations in Rapid-Reaction and Localized-Conflict

Scenarios; Jun. 1996; 10p; In English; Also announced as 19960053042; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Differential global positioning system (DGPS) adaptive filtering and anti-jam techniques are being evaluated to enhance the accuracy of the weapon in adverse weather as well as to reduce is susceptibility ot electronic countermeasures (ECM). This paper provides a comparison of two candidate DGPS techniques and their associated error budgets.
Derived from text

Adaptive Filters; Electronic Countermeasures; Jamming; Global Positioning System; Precision Guided Projectiles; Inertial Navigation; Weather

19960054042 Department of Transportation, John A. Volpe National Transportation Systems Center, Cambridge, MA USA

An Analysis of Tower (Ground) Controller - Pilot Voice Communications ***Final Report, Feb. 1993 - Nov. 1995***

Buerke-Cohen, Judith, Department of Transportation, USA; Nov. 1995; 35p; In English

Report No.(s): AD-A307868; DOT-VNTSC-FAA-95-41; DOT/FAA/AR-96/19; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report is based on an analysis of over 48 hours of pilot-controller communications recorded from the ground-control frequency at twelve air traffic control towers. The analysis examined the complexity of controller instructions, that is, how many pieces of information a single controller transmission contains. It looked at how pilots respond to these instructions, and whether the type of response was affected by the complexity of the instructions. Particularly, it studied the effect of complexity of the instructions on com munication problems, such as when pilots asked controllers to repeat their instructions or when they made an error in the readback. It also examined the incidence and possible causes of callsign confusions as well as of conceptuaL errors in pilot-controller communications. Lastly it compared the incidence of communication problems with the transmission density (transmissions per minute) at a facility. It related these findings to what was observed in the en-route (Cardosi), terminal-radar (TRACON; Morrow, Lee, and Rodvold) and in the tower-local control (Cardosi) environment. In conclusion a series of recommendations is presented.
DTIC

Air Traffic Control; Air Traffic Controllers (Personnel); Airport Towers; Data Transmission; Ground Based Control; Voice Communication

19960054897 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Jiangsu, China

A New Algorithm for Optimal Terrain Following/Terrain Avoidance Trajectory

Yuan, Weidong, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Wang, Jianping, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Shen, Chunlin, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Journal of Nanjing University of Aeronautics and Astronautics; Aug. 1996; vol. Volume 28, no. No. 4, pp. 481-486; In Chinese; Also announced as 19960054891; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The calculation of the optimal terrain following/terrain avoidance trajectory is the core of the integrated terrain following/terrain avoidance control system which is a new technique of low altitude penetration. This paper presents a new TF/TA optimization approach to calculate in real-time the optimum TF/TA trajectory. The optimization technique is an integrated application of the dynamic programming and tree searching. The algorithm takes into account the flight maneuvering constraints, so flyable trajectory is obtained without the need for any additional smoothing to assure that all flight constraints are met. Also, the effect of threat is considered, thus, the optimal trajectory generated can efficiently evade threat. The computer results are provided to show that the optimum trajectory generated is able to efficiently avoid terrain and evade threat.
Author

Terrain Following; Terrain Analysis; Trajectory Optimization; Real Time Operation; Algorithms

19960054898 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Jiangsu, China

Initial Alignment Systems of Inertial Navigation Using BP Neural Network

Yang, Li, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Wang, Shuhua, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Journal of Nanjing University of Aeronautics and Astronautics; Aug. 1996; vol. Volume 28, no. No. 4, pp. 487-491; In Chinese; Also announced as 19960054891; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

A filter based on a multilayer neural network for stochastic systems is developed for use in the inertia navigation initial alignment. The type of BP neural network instead of the closed-loop Kalman filter in the initial alignment can keep the error small, and implement the function of estimation and alignment in the inertia navigation. This filtering structure can provide distinct advantages. It is simpler for the system's algebra structure and more attractive for real time than classical filters. Simulation results show that its precision is similar to that of the Kalman filter.
Author

Inertial Navigation; Neural Nets; Real Time Operation; Filters

19960055148 Wyndemere, Inc., ,Boulder,CO USA

Air Traffic Complexity Measurement Environment (ACME): Software User's Guide ***Final Report***

1996; 30p; In English
Contract(s)/Grant(s): NAS2-14284
Report No.(s): NASA-CR-202455; NAS 1.26:202455; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A user's guide for the Air Traffic Complexity Measurement Environment (ACME) software is presented. The ACME consists of two major components, a complexity analysis tool and user interface. The Complexity Analysis Tool (CAT) analyzes complexity off-line, producing data files which may be examined interactively via the Complexity Data Analysis Tool (CDAT). The Complexity Analysis Tool is composed of three independently executing processes that communicate via PVM (Parallel Virtual Machine) and UNIX sockets. The Runtime Data Management and Control process (RUNDMC) extracts flight plan and track information from a SAR input file, and sends the information to GARP (Generate Aircraft Routes Process) and CAT (Complexity Analysis Task). GARP in turn generates aircraft trajectories, which are utilized by CAT to calculate sector complexity. CAT writes flight plan, track and complexity data to an output file, which can be examined interactively. The Complexity Data Analysis Tool (CDAT) provides an interactive graphic environment for examining the complexity data produced by the Complexity Analysis Tool (CAT). CDAT can also play back track data extracted from System Analysis Recording (SAR) tapes. The CDAT user interface consists of a primary window, a controls window, and miscellaneous pop-ups. Aircraft track and position data is displayed in the main viewing area of the primary window. The controls window contains miscellaneous control and display items. Complexity data is displayed in pop-up windows. CDAT plays back sector complexity and aircraft track and position data as a function of time. Controls are provided to start and stop playback, adjust the playback rate, and reposition the display to a specified time.
CASI
Applications Programs (Computers); User Manuals (Computer Programs); Flight Plans; Trajectory Planning; Air Traffic Control

19960055149 Wyndemere, Inc., Boulder, CO USA
Dynamic Resectorization and Coordination Technology: An Evaluation of Air Traffic Control Complexity ***Final Report***
Brinton, Christopher R., Wyndemere, Inc., USA; Oct. 31, 1996; 149p; In English
Contract(s)/Grant(s): NAS2-14284
Report No.(s): NASA-CR-202457; NAS 1.26:202457; N1-1996; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The work described in this report is done under contract with the National Aeronautics and Space Administration (NASA) to support the Advanced Air Transportation Technology (AATR) program. The goal of this program is to contribute to and accelerate progress in Advanced Air Transportation Technologies. Wyndemere Incorporated is supporting this goal by studying the complexity of the Air Traffic Specialist's role in maintaining the safety of the Air Transportation system. It is envisioned that the implementation of Free Flight may significantly increase the complexity and difficulty of maintaining this safety. Wyndemere Incorporated is researching potential methods to reduce this complexity. This is the final report for the contract.
Author
Air Transportation; Free Flight; Air Traffic Control; Flight Safety; Aerospace Safety; Safety Management

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19960051286 Wright Lab., Materials Directorate., Wright-Patterson AFB, OH USA
Proceedings of the 1994 USAF Structural Integrity Program Conference ***Final Report, 6 - 8 Dec. 1994***
Cooper, Thomas D., Wright Lab., USA; Lincoln, John W., Aeronautical Systems Div., USA; Rudd, James L., Wright Lab., USA; Feb. 1996; 656p; In English, 6-8 Dec. 1994, San Antonio, TX, USA; Also announced as 19960051287 through 19960051317
Contract(s)/Grant(s): AF Proj. 2418
Report No.(s): WL-TR-96-4030; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

This report contains the proceedings of the 1994 USAF Structural Integrity Program Conference held at the Hyatt Regency Hotel in San Antonio, Texas from 6-8 December 1994. The conference, which was sponsored by the Aeronautical Systems Center's Engineering Directorate and the Wright Laboratory's Flight Dynamics and Materials Directorates, was hosted by the San Antonio Air Logistics Center Aircraft Directorate, Aircraft Structural Integrity Branch (SA-ALC/LADD). This conference, as in previous years, was held to permit experts in the field of structural integrity to communicate with each other and to exchange views on how to improve the structural integrity of military weapon systems. Sessions were primarily focused on analysis and testing, engine structural integrity, structural materials and inspections, structural repair, and force management. This year, as in previous years, our friends from outside the U.S. borders provided the audience with outstanding presentations on activities within their countries. It is anticipated that this conference will include their contributions in the agenda of future meetings. This year eighteen countries were represented in the audience.
Author
Aircraft Structures; Structural Failure; Aircraft Mainte-

nance; Conferences; Inspection; Reliability; Service Life; Fatigue Life; Aging (Materials); Life (Durability)

19960051287 McDonnell-Douglas Aerospace, Transport Aircraft., Long Beach, CA USA

C-17 Full Scale Durability Test Program

Eastin, Robert G., McDonnell-Douglas Aerospace, USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 3-40; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The slides used in a presentation on the overview of the durability testing performed on test article 'D1', the C-17 durability airframe, are depicted. Topics discussed include: design usage; life verification requirements; test article description; test setup; test article loading; spectrum development and characteristics; inspection program, results obtained to date; and lessons learned/relearned.

Derived from text

Full Scale Tests; C-17 Aircraft; Service Life; Aircraft Structures; Structural Analysis; Aircraft Design; Aircraft Specifications; Performance Tests; Loads (Forces); Damage Assessment

19960051288 Southwest Research Inst., San Antonio, TX USA

ASIP Initiatives for the T-38 Aircraft

Burnside, O. Hal, Southwest Research Inst., USA; Dubke, Jonathan P., San Antonio Air Logistics Center, USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 41-64; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

For almost 34 years, the T-38 has been used by the USA Air Force (USAF) as an advanced fighter trainer. No other aircraft in aviation history has fulfilled this mission over such a long period. More remarkably, the USAF would like to fly the T-38 until the year 2020, and possibly beyond, which would make the T-38 sixty years old at retirement. Not only is the service time much longer than originally expected, but current and future training environments represent fighter missions that are more severe than that for which the T-38 was originally designed. This requires that the USAF maintain an active structural integrity program (ASIP) for the T-38. This paper reviews the development and evolution of the T-38 structure over the past 34 years and addresses initiatives being undertaken by the USAF to ensure structural integrity over its remaining life.

Author

T-38 Aircraft; Structural Design Criteria; Structural Reliability; Aircraft Structures; Service Life; Aircraft Design; Fatigue Life; Pilot Training

19960051289 Lockheed Aeronautical Systems Co., Marietta, GA USA

C-141 Starlifter: ASIP Methodology in an Aging Aircraft Environment

Cochran, Joseph B., Lockheed Aeronautical Systems Co., USA; Alford, Russell E., Air Force Logistics Command, USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 171-188; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The C-141 Starlifter is a successful story for an Aircraft Structural Integrity program (ASIP) in an aging aircraft environment. From its beginnings in 1968 until the present, the C-141 has a remarkable history of structural integrity, even though the first 20,000 hours of its service life was based on Miner's fatigue methodology. At the 20,000 hour mark, the C-141 underwent a 'stretch' program to lengthen its fuselage and add aerial refueling capability. At the same time, fracture mechanics methodology became the basis for its service life management. From the very outset, a complete and thorough database of service experience was initiated and maintained. Today, the C-141 ASIP has evolved into an individual aircraft management system that operates on a current time database that is near 100% electronic using PC's and work station computers. This presentation takes the viewer through the C-141 ASIP trail and shows how today's aircraft management program has evolved.

Author

C-141 Aircraft; Aircraft Structures; Service Life; Refueling; Fatigue Life; Configuration Management; Logistics Management

19960051290 Israel Aircraft Industries Ltd., Engineering Div., Ben-Gurion Airport, Israel

Probabilistic Inspection Strategies: A Key to Controlling Multi-Site Damage

Brot, Abraham, Israel Aircraft Industries Ltd., Israel; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 191-206; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

A simulation method is described which provides strategies for optimum scheduling of structural inspections. The aim of the method used is to simulate the aircraft service life and to determine the probability of failure for various nondestructive investigation (NDI) methods and schedules. The simulation method studies the effects of mean service life, damage tolerance methodology, inspection thresholds, and customized inspections on the probability of failure. The multi-site damage phenomenon is studied in detail and the simulation method is used to recommend strategies for for controlling failures.

Author

Service Life; Computerized Simulation; Schedules;

Predictions; Failure Analysis; Crack Initiation; Nondestructive Tests

19960051293 Georgia Tech Research Inst., Atlanta, GA USA
Progress Towards a Comprehensive Fatigue Analysis Program for Rotary and Fixed-Wing Aircraft
Bates, Preston R., Georgia Tech Research Inst., USA; Chamberlain, Gary, Air Force Logistics Command, USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 271-304; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

In order to ensure the structural integrity of aging weapons systems under their ever-increasing mission severity, the U.S. Air Force (USAF) has spearheaded a developmental integrity and force management concept applied to helicopters based on the success of their fixed wing counterparts. The specific goals of the program are to: (1) enhance aircraft safety, (2) improve maintenance procedures, (3) increase mission capability, and (4) lower life cycle costs. This paper documents work completed as part of a series of tasks required to develop a structural integrity computer program (SICP) in support of the H-53 aircraft structural integrity program (ASIP) and other aging aircraft in the fleet. After a general description of the SICP results are detailed of a task comparing available linear elastic fracture mechanics techniques with emphasis on stress intensity factor solutions, and which recommends specific crack growth technology to use in further SICP development.
Derived from text
H-53 Helicopter; Life Cycle Costs; Structural Failure; Cost Reduction; Service Life; Fatigue Life; Crack Propagation

19960051294 E-Systems, Inc., Greenville, TX USA
Composite Repair Durability/Damage Tolerance Test of C/KC-135 F.S. 880 Floor Beam
Chung, Jaycee H., E-Systems, Inc., USA; Arrieta, Albert J., Air Force Logistics Command, USA; Beard, Jon, Air Force Logistics Command, USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 353-373; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The fuselage station (FS) 880 floor beams of C/KC-135 aircraft are experiencing cracking after 30 years of service. Composite repair technology was applied to the floor beams for repair and structural life enhancement. A series of flight tests was conducted to measure the strain magnitudes on the hot spot of the floor beam for each mission segment of C/KC-135 aircraft. Using a KC-135R mission profile and mixes, a stress spectrum was developed for a durability/damage tolerance test of a composite repaired FS 880 floor beam. A series of static strain surveys on an FS 880 floor beam were conducted in a laboratory environment with and without composite doublers installed, prior to the durability/damage tolerance test. A design limit load was applied after 50 years of cyclic fatigue loads application. Then, a through-the-thickness crack was introduced to the hot spot connecting a fastener hole to the triangular cutout of the floor beam for the damage tolerance test. Another 50 years of cyclic loads were applied to the beam, and a limit load was applied after the cyclic loads application. Non-destructive inspections (NDI's) during and after the test revealed no indication of degradation of composite repair integrity.
Author
C-135 Aircraft; Cyclic Loads; Flight Tests; Beams (Supports); Yield Point; Composite Materials; Aircraft Construction Materials; Damage Assessment; Crack Initiation

19960051310 Royal Australian Air Force, Aircraft Structural Integrity Section., Melbourne, Australia
Aircraft Structural Integrity Management in the Royal Australian Air Force
Saunder, Terry J., Royal Australian Air Force, Australia; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 673-688; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Aircraft structural integrity (ASI) is the ability of all structural elements of an aircraft to withstand normal operating loads within approved flight limitations, without collapse or unacceptable deformation and, hence, ASI is an important dimension of technical airworthiness. The emphasis which major international military airworthiness authorities place on the management of aircraft structure demonstrates the importance of ASI. The Royal Australian Air Force (RAAF) has a history of maintaining aircraft in service long beyond expectations and also in a unique operational environment. As a consequence, technical airworthiness is paramount. Recently there has been the motivation for all airworthiness authorities to review their structural integrity management practices in light of aging aircraft issues. Although the RAAF has been working on the entirety of its technical airworthiness code, a consequence of two RAAF aircraft accidents in 1990 has been the review and re-focusing of RAAF ASI management. In the last four years, RAAF structural integrity management has developed. It now reflects an entrenched RAAF ASI program (ASIP), well-defined procedures, and the intention to prepare an overarching doctrinal basis for RAAF structural integrity management.
Author
Aging (Materials); Aircraft Reliability; Aircraft Structures; Structural Failure; Structural Design Criteria; Aircraft Maintenance

19960051313 Canadian Marconi Co. Ltd., Montreal, Quebec Canada
A Fiber-Optic Loads Monitoring System for the CL-600 Challenger Aircraft

Blaha, Franz A., Canadian Marconi Co. Ltd., Canada; Grenier, L., National Defence Headquarters, Canada; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 733-742; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The Challenger aircraft fleet of the Canadian Forces flies demanding missions requiring the implementation of a fatigue management program based on the monitoring of in-flight aircraft load conditions. Conventional sensing techniques impose a limit on the number of sensors which can be realistically employed, and experience problems arising from severe electromagnetic interference (EMI). This paper describes the development of an EMI-insensitive loads monitoring system. Fiber optic (FO) strain gages are incorporated at critical structural locations in the aircraft wing, fuselage, and empennage. Concept and features of the FO sensors and system are presented, together with a long-term plan for the development of a smart structure concept which can support the continuous monitoring of fatigue-prone components, and provide the aircraft with near real-time damage location and assessment.

Author

CL-600 Challenger Aircraft; Damage Assessment; Electromagnetic Interference; Fiber Optics; Loads (Forces); Real Time Operation; Smart Structures; Strain Gages

19960051314 Naval Air Warfare Center, Warminster, PA USA

Improving Predictions for Helicopter Usage Monitoring

Hoffman, Margery E., Naval Air Warfare Center, USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 743-765; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The goal of Navy helicopter usage monitoring research is to predict the rotor system and fixed system loads suitable for fatigue calculations. It is not practical to measure helicopter loads on main rotor components during typical flight operations so methods are being developed that predict loads from information gained through instrumented flight tests. Emphasis has been placed on developing regression, neural network, and holometric models for predicting blade bending and lag damping loads. to date, the best results have been obtained using regression models to predict the maximum load that occurs during a maneuver. Neural networks and holometrics have been used successfully in some cases to predict peak and valley loads that occur during specific maneuvers or in specified regimes. All three models can be improved by carefully preparing the data prior to using them to calibrate the model. This paper presents the effect of training data selection on the load predictions for neural network models using a sample of CH-46 data.

Author

Flight Tests; Mathematical Models; Calibrating; Rotary Wings; Damping; Loads (Forces); Neural Nets; Prediction Analysis Techniques; Data Sampling

19960051316 Aero Vodochody A.S., Odolena Voda, Czechoslovakia

Aircraft Structural Integrity Program for the Aero Vodochody L 139 Jet Trainer

Fidransky, Jiri, Aero Vodochody A.S., Czechoslovakia; Trabert, Mark, Esprit Technology, Inc., USA; Ghannadan, Ali, Esprit Technology, Inc., USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 785-793; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Sufficient service life and service reliability are important features of both military and commercial aircraft. There are a number of tasks necessary to ensure successful development and operational service. The Czech Republic company Aero Vodochody, has a long history of manufacturing military aircraft, having been the primary supplier of advanced trainers to most of the former Warsaw Pact and some other countries. Aero plans to implement the loads environment spectrum survey (LESS) and individual aircraft tracing (IAT) programs for the L-139 trainer production. An ESPRIT technology flight data recording system is installed to process and record desired flight data. Analysis of these flight data and their effect on the fatigue life of the aircraft's structure will be accomplished by Aero using a self-designed software program. Aero's basic philosophy is to assess most structural components using a safe life approach, however, some fatigue critical components are evaluated using a damage tolerance methodology. Flight data expressing the loading sequence of individual aircraft enables Aero to estimate crack initiation/crack growth. In some cases, strain gages are used to directly monitor loads in certain fatigue critical locations. Current results show that implementing this program will at least double the aircraft's service life without structural modifications.

Author

Aircraft Structures; Training Aircraft; Manufacturing; Strain Gages; Structural Design; Tolerances (Mechanics); Data Recording; Fatigue Life; Service Life

19960051317 Chrysler Technologies Airborne Systems, Inc., Waco, TX USA

A Simplified Approach to Repeated Loads Development

Manders, Chris, Chrysler Technologies Airborne Systems, Inc., USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 795-838; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper outlines the development of simplified load spectra for use in preliminary fatigue assessments. The simplified generation approach uses a limited amount of external

load information with a potentially large reduction in the number of external load cases required, when compared to conventionally generated spectra. It presents analytical and test fatigue life data for the conventional, multiple load case spectra and the simplified spectra.
Author
Fatigue Life; Loads (Forces); Aircraft Structures; Service Life; Stress Cycles; Fatigue (Materials); Cyclic Loads

19960051458 National Aerospace Lab., Kakuda, Japan
Evaluation of the flying qualities of the flight research airplane Do228 using a V-ghamma Diagram
Hozumi, Koki, National Aerospace Lab., Japan; Sakai, Toshiho, National Aerospace Lab., Japan; 1996; ISSN 0452-2982; 24p; In Japanese
Report No.(s): NAL-TR-1288; UDC 6297.018.7; UDC 629.7.016; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this study, the flying qualities of the Flight Research Airplane Do228 were evaluated. by performing some flight tests using a Do228, the V-Gamma diagrams with some configurations were drawn out. The flight performance was obtained, and some longitudinal aerodynamic derivatives such as Xu, Xw, Zu and Zw were estimated from the performance. The parameter errors were examined by comparing the above parameters with those based on the wind-tunnel tests. According to the results, the accuracy of the parameters estimated from V-Gamma diagrams was sufficient to discuss the longitudinal dynamics.
Author
Flight Characteristics; Flight Tests; Research Aircraft; Aerodynamics

19960052156 Loyola Coll., Baltimore, MD USA
Factorial Design: An Eight Factor Experiment Using Paper Helicopters
Kozma, Michael, Loyola Coll., USA; National Educators' Workshop: Update 95. Standard Experiments in Engineering Materials Science and Technology; May 1996, pp. 131-148; In English; Also announced as 19960052141; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The goal of this paper is to present the analysis of the multi-factor experiment (factorial design) conducted in EG490, Junior Design at Loyola College in Maryland. The discussion of this paper concludes the experimental analysis and ties the individual class papers together.
Derived from text
Factorial Design; Mathematical Models; Statistical Analysis; Helicopters

19960052435 Naval Postgraduate School, Monterey, CA USA
Procedural Guide for Modeling and Analyzing the Flight Dynamics of the SH-60B Helicopter Using Flightlab
Wagner, Roy C., Naval Postgraduate School, USA; Sep. 1995; 180p
Report No.(s): AD-A305994; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

This thesis uses Flightlab to model and analyze the flight dynamics of the SH-6OB Seahawk helicopter. Flightlab runs on computers utilizing the UNIX operating system and is used for design, analysis and testing of an aircraft using non-linear modeling techniques. It is capable of modeling conventional main rotor-tail rotor and tandem rotor helicopters and tilt rotor aircraft. A procedural guide for modeling and analyzing a single main rotor helicopter is presented using the SH-60B. The non-linear response from lateral and longitudinal cyclic, main rotor collective and tail rotor collective inputs are presented. Flightlab is also capable of reducing the non-linear model to a linear model. The linear and non-linear models are then compared. The purpose of this thesis is to present a guide for using Flightlab to model and analyze an existing helicopter design, and also to have in place a well tested model to be used for further research.
DTIC
Computerized Simulation; Tandem Rotor Helicopters; Computer Programs; Computer Aided Design; UNIX (Operating System); Helicopter Design; Operating Systems (Computers); Design Analysis

19960052589 Naval Postgraduate School, Monterey, CA USA
Durability Modeling and Design of a Helicopter Rotor Tie Bar
Sauter, Gregory Paul, Naval Postgraduate School, USA; Sep. 1995; 81p; In English
Report No.(s): AD-A306021; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The CH.46 Tie Bar is a multiple leaf, stainless steel system that attaches the rotor blade to the rotating hub and carries rotor blade centrifugal force. The Tie Bar twists as the rotor blade feathers and bends slightly as the Pitch Housing bends. Originally designed to last 3,000 hours without any component breakages, the Tie Bar has experienced field failures that have necessitated inspections every 10 flight hours. Traditional fatigue qualification and life methodology have not reconciled the unusually large number of CH-46 Tie Bar component failures. One CH-46 experienced 15, 10, and 6 component failures on the three aft rotor head Tie Bars after only 93 flight hours. One complete Tie Bar (140 components) failed and caused an aircraft crash. This research developed a probability modeling predictive method that can aid the design of a Tie Bar that will meet desired life and reliability levels. Laboratory coupon tests were interpreted to provide material properties for several manufacturing processes. Finite element analysis of the current Tie Bar design as well as two modified designs was used to determine the Tie Bar stress state for many component failure combinations. The

reduced constraint design produced a dramatic stress concentration reduction and may provide large gains in life over the current and elliptical slot designs.
DTIC
Rotary Wings; CH-46 Helicopter; Centrifugal Force; Aircraft Accidents; Failure; Component Reliability

19960052852 Naval Postgraduate School, Monterey, CA USA
Final Modifications of NPS Hummingbird Remotely Piloted Helicopter in Preparation for Flight
Booth, Andrew J., Naval Postgraduate School, USA; Dec. 1995; 54p; In English
Report No.(s): AD-A306228; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The goals of this thesis were to make final design modifications and perform static testing to prepare the Hummingbird, a 150 pound, Remotely Piloted Helicopter (RPH), for untethered flight. The major elements involved were: (1) The adaptation of a suitable, permanently-dedicated test stand for use with large-scale RPH/RPV (remotely piloted vehicle) aircraft; (2) A major rotor drivetrain improvement to the helicopter to enable it to autorotate and safely land in the event of an in-flight engine failure, thus avoiding potential loss of the helicopter due to crash; (3) Complete break-in and testing of a replacement engine for a mechanically-seized first engine; and (4) Limited hover testing while secured to the tether test stand. Test stand modifications include design and implementation of a compression spring to offset the weight of the new mounting assembly and a restricting collar to confine mobility of the stand's universal joint. The mechanical change to the drivetrain consists of replacement of a conventional belt-drive sprocket with a one-way sprague clutch bearing inside the gear. This provides the Hummingbird with the critical capability to autorotate. The new engine, correctly broken in, and the subsequent static testing provide the Department of Aeronautics and Astronautics with an operational platform ready to perform subsequent in-flight testing.
DTIC
Remotely Piloted Vehicles; Flight Tests; Helicopters

19960052861 Advisory Group for Aerospace Research and Development, Structures and Materials Panel, Neuilly-Sur-Seine, France
Structures and materials panel working group 27 on evaluation of loads from operational flight maneuvers
Apr. 1996; 124p; In English
Report No.(s): AGARD-AR-340; Copyright Waived; Avail: CASI; A06, Hardcopy; A02, Microfiche

This AGARD Advisory Report describes an evaluation of a method to derive loads from operational flight maneuvers. The basic assumption of this method is that all operational maneuvers performed in service can be verified as a set of Standard Maneuvers (normalized parameter time histories for each independent maneuver type). The verification of Standard Maneuvers is based on recordings of relevant maneuver parameters in service and for new tactics/missions on special flights or simulations. The initial evaluation of the concept done by the Working Group (WG.27) has demonstrated the feasibility of determining loads from operational flight maneuvers.
Author
Aircraft Maneuvers; F-16 Aircraft; Load Distribution (Forces); F-18 Aircraft; Flight Tests

19960053195 National Research Council of Canada, Inst. for Aerospace Research, Ottawa, Ontario Canada
The Computation of Aircraft Store Trajectories Using Hybrid (Structured/Unstructured) Grids
Jones, D. J., National Research Council of Canada, Canada; Fortin, F., National Research Council of Canada, Canada; Hawken, D., National Research Council of Canada, Canada; Syms, G. F., National Research Council of Canada, Canada; Sun, Y., National Research Council of Canada, Canada; Progress and Challenges in CFD Methods and Algorithms; Apr. 1996; 12p; In English; Also announced as 19960053167; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

With the high costs associated with flight and wind tunnel testing, the computation of aircraft store trajectories is becoming more important to the military establishment. In Canada, the Department of National Defense (DND) requested IAR to acquire/develop the necessary tools to carry out the prediction of stores on release from aircraft - particularly the DND's CF-18 aircraft. After debating whether to use structured Chimera schemes or unstructured schemes, IAR decided to use the latter techniques as there was already a development program in that field of research. IAR had already demonstrated that hybrid (structured/unstructured) grids had produced successful results and decided to pursue this approach for the unsteady 3D computations. to this end, a study was made in the 2D case of a 'store' moving from the parent 'body'. Grid generation is underway for the full CF-18 aircraft using a commercial code and several simpler cases have been gridded and computations made in a steady 3D environment.
Author
Grid Generation (Mathematics); Computational Grids; Computational Fluid Dynamics; F-18 Aircraft; Trajectory Analysis; Ordnance; Computerized Simulation

19960053904 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Methodology For Implementing Fracture Mechanics In Global Structural Design of Aircraft
Nees, Clifton D., Air Force Inst. of Tech., USA; Dec. 1995; 126p; In English
Report No.(s): AD-A306563; AFIT/GAE/ENY/95D-18; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The analysis and design criteria of fracture mechanics are investigated for implementation with the Automated Structural Optimization System (ASTROS) global optimization design tool. The main focus is the optimal design of aircraft wing panels by applying fracture mechanics design criteria within the global finite element model. This effort consists of four main phases: investigation of fracture mechanics analysis methods and design criteria, formulation of a computational technique for damage tolerance design consistent with global optimization requirements, integration of the technique into the ASTROS design tool, and demonstration of the results.
DTIC
Design Analysis; Aircraft Structures; Tolerances (Mechanics); Systems Engineering; Finite Element Method; Structural Design

19960053905 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
An Assessment of the Impact of Fuel Jettisoning Events Using Simulation and Impact Models
Todd, Jeffrey M., Air Force Inst. of Tech., USA; Dec. 1995; 109p; In English
Report No.(s): AD-A306554; AFIT/GEE/ENC/95D-01; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Work has been accomplished to determine the impact of jettisoned fuel when it reaches the surface. While previous work indicates that jettisoning JP-4 jet fuel results in a negligible ground fall impact, the impact of jettisoning lower volatile JP-8 jet fuel has not been thoroughly characterized. Several efforts have been made to mathematically model the evaporation, advection, and dispersion of the plume of fuel as it travels to the surface. The AFIT Fuel Jettisoning Model, the Fuel Jettisoning Simulation Model, and Fuel-Dumping Impact Assessment Model were evaluated and compared to assess the impact of jettisoned JP-8 jet fuel. Additionally, the AFIT Model has been modified to include surface evaporation to evaluate the time required to evaporate JP-8 jet fuel after it reaches the surface. While JP-8 jet fuel does impact the surface more than JP-4 jet fuel, the mass of JP-8 jet fuel remaining from releases at altitudes greater than 6000 meters and at surface temperatures greater than 0 C can evaporate within hours. We conclude that the recommended jettison release altitude for large body aircraft of 6000 meters is adequate.
DTIC
JP-4 Jet Fuel; JP-8 Jet Fuel; Jettisoning; Damage Assessment; Evaporation; Surface Temperature

19960053928 Federal Aviation Administration, Research and Development Div. FAA Technical Center., Atlantic City, NJ USA
Aircraft Cabin Smoke Control with Converging-Diverging Nozzles
Eklund, Thor I., Federal Aviation Administration, USA; Apr. 1996; 37p; In English
Report No.(s): AD-A306964; DOT/FAA/AR-TN-96/37; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The characteristics of converging-diverging nozzles are compared to those of converging nozzles for use in aircraft cabin smoke control. The peak flow flight regimes for the two different nozzles are compared by means of test data taken on a Boeing 757. The converging-diverging nozzle is shown as capable of maintaining peak volumetric flow over a wide range of airplane cabin pressure and flight altitude combinations. Sample capacities and flow schedules are presented for installation of converging-diverging nozzles in Boeing 737 aircraft.
DTIC
Convergent-Divergent Nozzles; Smoke; Aircraft Compartments; Fire Prevention; System Effectiveness

19960054170 Air Force Inst. of Tech., Graduate Aeronautical Engineering, Wright-Patterson AFB, OH USA
Investigation of Aerodynamic Alterations for Improving the KC-135 Boom Performance During Aerial Refueling
Nawrocki, Debra A., Air Force Inst. of Tech., USA; Dec. 1995; 140p; In English
Report No.(s): AD-A306782; AFIT/GAE/ENY/95D-17; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This study investigated the eligibility of the KC-135 air refueling boom for improved capabilities in the areas of control and performance. by using a thick airfoil cross-section for the boom tube, rather than the current circular cross-section, the ability to increase the lift characteristics was verified. Prior compiled test data was used for comparison against analytical computer solutions. The possibility and effects of control frequency oscillations were also examined due to the unstable nature of the flow at test conditions. Additionally, the effect of other cross-section shapes, such as the blunt fairing, on the size of the flyable envelope for the trailing aircraft was investigated by using FORTRAN coding. Results show that the KC-135 air refueling boom can be modified for better lift and performance envelope capabilities.
DTIC
Air to Air Refueling; C-135 Aircraft; Airfoil Profiles; Lift; Computerized Simulation

19960054343 California Univ., Dept. of Mechanical and Aeronautical Engineering, Davis, CA USA
Design Methodology for Multi-Element High-Lift Systems on Subsonic Civil Transport Aircraft *Final Report*
Pepper, R. S., California Univ., USA; vanDam, C. P., California Univ., USA; Aug. 1996; 109p; In English
Contract(s)/Grant(s): NCC2-5042
Report No.(s): NASA-CR-202365; NAS 1.26:202365; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The choice of a high-lift system is crucial in the preliminary design process of a subsonic civil transport aircraft. Its purpose is to increase the allowable aircraft weight or decrease the aircraft's wing area for a given takeoff and landing performance. However, the implementation of a high-lift system into a design must be done carefully, for it can improve the aerodynamic performance of an aircraft but may also drastically increase the aircraft empty weight. If designed properly, a high-lift system can improve the cost effectiveness of an aircraft by increasing the payload weight for a given takeoff and landing performance. This is why the design methodology for a high-lift system should incorporate aerodynamic performance, weight, and cost. The airframe industry has experienced rapid technological growth in recent years which has led to significant advances in high-lift systems. For this reason many existing design methodologies have become obsolete since they are based on outdated low Reynolds number wind-tunnel data and can no longer accurately predict the aerodynamic characteristics or weight of current multi-element wings. Therefore, a new design methodology has been created that reflects current aerodynamic, weight, and cost data and provides enough flexibility to allow incorporation of new data when it becomes available.
Author
Structural Weight; Transport Aircraft; Aircraft Performance; Wing Profiles; Lift; Cost Effectiveness; Computer Aided Design

19960054454 Eurofighter Jagdflugzeug G.m.b.H., Hallbergmoos, Germany
Propulsion Integration Aspects in Advanced Military Aircraft
Hienz, E., Eurofighter Jagdflugzeug G.m.b.H., Germany; Illuzzi, L., Eurofighter Jagdflugzeug G.m.b.H., Germany; Herrmann, P., Eurojet Turbo G.m.b.H., Germany; Advanced Aero-Engine Concepts and Controls; Jun. 1996; 18p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Historically, airframe/engine integration was mainly related to physical aspects requiring only a low degree of sophistication. With the advent of more overall system performance consciousness, propulsion integration has become a major task split between airframe and engine engineers. It now includes performance, functional and physical aspects all needing to be integrated to meet specific requirements. Aircraft and engine configurations are therefore optimized simultaneously at a very early stage of development. Some of the major interfaces influencing configuration, performance, and operability are discussed, i.e., intake/engine/afterbody; and electronic controls integration (including monitoring); performance optimization, systems, and installation.
Author
Aircraft Engines; Engine Airframe Integration; Propulsion System Configurations; Control Systems Design; Systems Integration; Inlet Airframe Configurations

19960054468 California Polytechnic State Univ., Aeronautical Engineering Dept., San Luis Obispo, CA USA
Subsonic Wing Optimization for Handling Qualities using ACSYNT *Final Report*
Soban, Danielle Suzanne, California Polytechnic State Univ., USA; Sep. 1996; 46p; In English
Contract(s)/Grant(s): NCC2-855
Report No.(s): NASA-CR-202405; NAS 1.26:202405; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

The capability to accurately and rapidly predict aircraft stability derivatives using one comprehensive analysis tool has been created. The PREDAVOR tool has the following capabilities: rapid estimation of stability derivatives using a vortex lattice method, calculation of a longitudinal handling qualities metric, and inherent methodology to optimize a given aircraft configuration for longitudinal handling qualities, including an intuitive graphical interface. The PREDAVOR tool may be applied to both subsonic and supersonic designs, as well as conventional and unconventional, symmetric and asymmetric configurations. The workstation-based tool uses as its model a three-dimensional model of the configuration generated using a computer aided design (CAD) package. The PREDAVOR tool was applied to a Lear Jet Model 23 and the North American XB-70 Valkyrie.
Author
Computer Aided Design; Aircraft Stability; Aerodynamic Stability; Applications Programs (Computers); Vortex Lattice Method; Three Dimensional Models

19960054488 Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine, France
Aging Combat Aircraft Fleets- Long Term Applications *les Consequences a Long Terme du Vieillissement des Flottes d'Avions de Combat*
1996; 240p; In English; The Structures and Materials Panel of AGARD and the Consultant and Exchange Programme of AGARD, 7 - 8 Oct. 1996, Madrid, Pomezia, Atlanta, GA, Brussels, Spain, Italy, USA, Belgium
Report No.(s): AGARD-LS-206; ISBN-92-836-1044-X; Copyright Waived; Avail: CASI; A11, Hardcopy; A03, Microfiche

This Lecture Series covers systems update and structural airworthiness aspects of aging, fixed-wing aircraft. It highlights the aspect of retrofit/rejuvenation of aging aircraft through presentations relating to three front-line combat aircraft in NATO's inventory. The presentations describe implementation strategies and ways to improve the ability of an airframe to accommodate new systems to meet present day mission requirements. Technical issues pertaining to structural safety, maintenance management, and proactive rehabi-

litation/retrofit schemes are also discussed. It provides technical information to fleet operators and managers to assist them to better manage aging aircraft fleets and be able to deal with aging related problems as they arise. It also targets industry personnel responsible for upgrading the capabilities of combat aircraft, maintenance personnel at air logistics centers, and specialists involved with the design of repairs and prescription of inspection methods. 'Aging aircraft' has several connotations, amongst them technological obsolescence, performance upgrading, changing mission requirements unanticipated during design specification and development, the specter of runaway maintenance costs, decreased safety, impairment of fleet readiness, and unavailability of home depot facilities.
Author
Fighter Aircraft; Airframes; Structural Design Criteria; Safety; Lectures

19960054501 Arizona State Univ., Dept. of Mechanical and Aerospace Engineering, Tempe, AZ USA
Modeling and Analysis of Composite Wing Sections for Improved Aeroelastic and Vibration Characteristics Using Smart Materials ***Progress Report, 1 Jan. - 30 Sep. 1996***
Chattopadhyay, Aditi, Arizona State Univ., USA; Oct. 04, 1996; 21p; In English
Contract(s)/Grant(s): NAG1-1648
Report No.(s): NASA-CR-202392; NAS 1.26:202392; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this research is to develop analysis procedures to investigate the coupling of composite and smart materials to improve aeroelastic and vibratory response of aerospace structures. The structural modeling must account for arbitrarily thick geometries, embedded and surface bonded sensors and actuators and imperfections, such as delamination. Changes in the dynamic response due to the presence of smart materials and delaminations is investigated. Experiments are to be performed to validate the proposed mathematical model.
Derived from text
Aircraft Structures; Composite Structures; Mathematical Models; Aeroelasticity; Structural Vibration; Smart Structures; Finite Element Method

19960054892 Nanjing Univ. of Aeronautics and Astronautics, Nanjing, Jiangsu, China
Development Study on the Three Seat FT300 Amphibian Light Aircraft
Guo, Xiaoliang, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Deng, Qinghua, Nanjing Univ. of Aeronautics and Astronautics, Nanjing, China; Journal of Nanjing University of Aeronautics and Astronautics; Aug. 1996; vol. Volume 28, no. No. 4, pp. 449-456; In Chinese; Also announced as 19960054891; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The design feature and technical performance of FT300 3-seat amphibian light aircraft are introduced. Some main technical problems include the large loads on composite structures, the match of the propeller with the engine, and the choice of the water dynamical parameter. Also discussed are the effects of the front wing position and the deflection of the elevator to the canard aircraft, the structural pattern of the floats, the strength check of the composite material aircraft and surveys of the tests and test flights. The main performance data and general parameters are shown, which are available as references for designers of light aircraft.
Author
Amphibious Aircraft; Aircraft Design; Light Aircraft; Aircraft Structures

19960055150 National Aeronautics and Space Administration, Washington, DC USA
Support of Helicopter 'Free Flight' Operations in the 1996 Olympics
Branstetter, James R., Federal Aviation Administration, USA; Cooper, Eric G., National Aeronautics and Space Administration, USA; 1996; ISSN 0148-7191; 16p; In English; 1996 World Aviation Congress, 21 - 24 Oct. 1996, Los Angeles, CA, USA; Sponsored by Society of Automotive Engineers, Inc., USA
Report No.(s): NASA-CR-110483; NAS 1.15:110483; AIAA Paper 965632; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The microcosm of activity surrounding the 1996 Olympic Games provided researchers an opportunity for demonstrating state-of-the art technology in the first large-scale deployment of a prototype digital communication/navigation/surveillance system in a confined environment. At the same time it provided an ideal opportunity for transportation officials to showcase the merits of an integrated transportation system in meeting the operational needs to transport time sensitive goods and provide public safety services under real-world conditions. Five aeronautical CNS functions using a digital datalink system were chosen for operational flight testing onboard 91 aircraft, most of them helicopters, participating in the Atlanta Short-Haul Transportation System. These included: GPS-based Automatic Dependent Surveillance, Cockpit Display of Traffic Information, Controller-Pilot Communications, Graphical Weather Information (uplink), and Automated Electronic Pilot Reporting (downlink). Atlanta provided the first opportunity to demonstrate, in an actual operating environment, key datalink functions which would enhance flight safety and situational awareness for the pilot and supplement conventional air traffic control. The knowledge gained from such a large-scale deployment will help system designers in development of a national infrastruc-

ture where aircraft would have the ability to navigate autonomously.
Author
Air Traffic Control; Global Positioning System; Surveillance; Flight Tests; Digital Systems; Air Transportation; Helicopters; Aircraft Communication; Air Navigation

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19960052073 Veda, Inc., Dayton, OH USA
Evaluation of Proposed C-141 Electronic Display Formats and Menus, volume 1, Part-Task simulation ***Final Report, 15 Sep. 1993 - 15 Oct. 1994***
Cone, Scott M., Veda, Inc., USA; Toms, Mona L., Veda, Inc., USA; Gier, Glenn R., Veda, Inc., USA; Brown, Tammy R., Veda, Inc., USA; Patzek, Michael J., Veda, Inc., USA; Aug. 1995; 196p; In English
Contract(s)/Grant(s): F33615-93-D-3800; AF Proj. 2403
Report No.(s): AD-A305191; WL-TR-95-3096; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The Warner-Robins Air Logistics center has initiated a program to replace the current cockpit flight instruments with a new Control/Display System (CDS). The new CDS includes: (1) Liquid Crystal Display (LCD) units for the presentation of electronic Primary Flight Display Formats; and (2) the addition of a Display Avionics Management Unit (DAMU) for controlling primary flight and navigation functions. The Wright Laboratory Cockpit Integration Division has supported this upgrade program through a two-phase pilot-in-the-loop simulation evaluation effort. In Phase the PFD format and the DAMU were evaluated in part-task simulations. In Phase II, a full mission evaluation was conducted to verify that the integrated system would support C-141 mission requirements. This report describes the methods and results of the part-task simulation. Four primary flight display formats (CDS Attitude, CDS Climb-Dive, C-141, and the T-1) were compared through a series of instrument flying tasks. Performance with the CDS displays was as good as or better than the others. However, numerous deficiencies were identified through questionnaires and pilot comments. Two DAMU menu designs (proposed CDS design, and a WL/FIP alternative design) were compared using a scripted role-playing task. Overall, performance and subjective results showed that both DAMU designs would be suitable for use in the C-141 with minor modifications. Specific recommendations are provided for both the CDS PFD format and DAMU design.
DTIC
C-141 Aircraft; Display Devices; Cockpits; Liquid Crystals; Mission Planning; Flight Instruments

19960052434 Analytic Sciences Corp., Reading, MA USA
Avionics Software Reengineering Technology (ASRET) Project. Project Summary, Account and Results, Volume 1 ***Final Report, 1 May 1992 - 1 May 1995***
Wilkening, D. E., Analytic Sciences Corp., USA; Loyall, J. P., Analytic Sciences Corp., USA; May 1995; 91p; In English
Contract(s)/Grant(s): F33615-92-D-1052; AF Proj 3090
Report No.(s): AD-A305829; TASC-TR-06661-4-VOL-1; WL-TR-95-1119; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The objective of the Avionics Software Technology Support (ASTS) program is to perform research and development for enhancing Embedded Computer System (ECS) software development and post-deployment support. The Avionics Software Reengineering Technology (ASRET) project is the second delivery order under ASTS. Under ASRET, we investigated existing reengineering and reverse engineering process, techniques, and software tools. Based upon this study, we developed a process model and environment for reengineering software from one language (FORTRAN) to another (Ada). We designed and implemented a Reengineering Tool (RET) prototype to assist the engineer in this process. We evaluated the RET by translating FORTRAN simulation code for Block 40 of the F-16 OFP to Ada. To prove the value of the RET, we recommend that software maintainers participate in an experiment using an enhanced RET to reengineer an application in a production environment rather than in a laboratory.
DTIC
Software Engineering; Computer Programming; Computerized Simulation; Environments; Prototypes; Coding; Fortran

19960052706 Analytic Sciences Corp., Reading, MA USA
Avionics Software Reengineering Technology (ASRET) Project Reengineering Tool (RET) User's Manual ***Final Report, May 1992 - May 1995***
Wilkening, D. E., Analytic Sciences Corp., USA; Loyall, J. P., Analytic Sciences Corp., USA; May 1995; 68p; In English
Contract(s)/Grant(s): F33615-92-D-1052; AF Proj. 3090
Report No.(s): AD-A305664; TASC-TR-1560-1; WL-TR-95-1118; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report explains how to use the Reengineering Tool (RET) prototype developed under the Avionics Software Reengineering Technology (ASRET) project. The RET prototype is a software reengineering tool that assists in improving and translating avionics simulation software written in FORTRAN to Ada.
DTIC
Software Engineering; User Manuals (Computer Programs); Computerized Simulation

19960052723 Analytic Sciences Corp., Reading, MA USA
Avionics Software Reengineering Technology (ASRET) Project, Volume 2, Reengineering Tool (RET) Diagrams
Final Report, 1 May 1992 - 1 May 1995
Wilkening, D. E., Analytic Sciences Corp., USA; May 1995; 180p; In English
Contract(s)/Grant(s): F33615-92-D-1052; AF Proj. 3090
Report No.(s): AD-A305705; TASC-TR-06661-5; WL-TR-95-1120; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

This document presents results of the Avionics Software Reengineering Technology (ASRET) project. It provides samples of output that we created using the Reengineering Tool (RET) prototype that we developed under ASRET, narrates our efforts to produce the output, and reports on insights that we gained in the process. A companion document, Volume, Project Summary, Account, and Results, presents the findings of the ASRET Project and describes the RET prototype and the context within which we produced the output.
DTIC
Applications Programs (Computers); Software Engineering

19960053058 Diehl G.m.b.H. und Co., Optoelectronics Div., Roethenbach, Germany
DIRCM: An Effective Technology for Aircraft Self Protection Against Optronic Missile Seekers
Noll, M., Diehl G.m.b.H. und Co., Germany; Warm, B., Diehl G.m.b.H. und Co., Germany; Kassens, P., Diehl G.m.b.H. und Co., Germany; Jun. 1996; 16p; In English; Also announced as 19960053042; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

This report discusses the influence of the parameters of a laser system (wave length, repetition rate and output power) and the requirements for a suitable tracking system including possible ways of implementing tracking system hardware and concepts for controller loop design, for a specific engagement design of the directed infrared countermeasures (DIRCM) system for aircraft self protection against optronic missile seekers.
Derived from text
Optical Countermeasures; Laser Weapons; Eye Protection; Military Aircraft

19960053283 Institute for Human Factors TNO, Soesterberg, Netherlands
Tactical Situation Displays: Integrated Versus Separate Information Presentation
Passenier, P. O., Institute for Human Factors TNO, Netherlands; vanDelft, J. H., Institute for Human Factors TNO, Netherlands; Nov. 30, 1995; 24p; In English
Report No.(s): AD-A306833; TNO-TM-1995-1-73; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In the scope of a study on tactical situation displays in the cockpit of modern fighter aircraft, a simulator experiment has been conducted on integrated ('highway in the sky') versus separate presentation of flight information. Results of the experiment show that the 'highway in the sky' especially for 'slow' tasks (slow in relation to aircraft dynamics) leads to more accurate flight performance because of the integrated feedback of the aircraft state, when compared to separate information presentation. However, for 'rapid tasks', where the emphasis is on feedforward control, the separate information presentation is to be preferred because of the more constant preview as a result of the decoupling of the information presentation along different dimensions.
DTIC
Cockpits; Display Devices; Flight Characteristics; Fighter Aircraft; Feedforward Control; Simulators

07
AIRCRAFT PROPULSION AND POWER

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

19960051295 Wright Lab., Wright-Patterson AFB, OH USA
Applying Probabilistic Concepts to Gas Turbine Engine Management
Pomfret, Christopher J., Wright Lab., USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 377-410; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This report discusses the application of probability theory (probabilistics) concepts to the management of gas turbine engine components. Specifically, the inspection of gas turbine disks indicates that they are inspected too frequently or that the disk is more capable and robust than expected. At present, crack-free components are retired for cause because they are deemed to have reached their predicted safe life cycle. The USAF is managing two independent programs to develop a probabilistic approach to help compute the design of a turbine disk. The approach has been to re-design, using probabilistically generated input values, a disk previously designed with deterministic inputs, and thus quantify the differences. A series of model disks, some built with known, seeded faults, will be cycled to failure and the type of failure will be compared with predicted failure modes. The potential for a cost reduction for components with no decline in aircraft safety factors is discussed.
CASI
Aircraft Safety; Cost Reduction; Engine Parts; Gas Turbine

Engines; Life (Durability); Engine Design; Probability Theory

19960051296 Georgia Inst. of Tech., Computational Modeling Center., Atlanta, GA USA

Effect of Multiple Blade Impact on Aircraft Engine Containment Structures During a Rotor Burst Failure

Sarkar, Subhasis, Georgia Inst. of Tech., USA; Atluri, S. N., Georgia Inst. of Tech., USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 411-426; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The objective of this study is to develop computational modeling techniques to analyze the impact of blade rotor fragments on containment structures. Rotor fragments, consisting of a single blade and three blades attached together, are released and the deformation response of the ring is computed. The collision of the rotor fragments with the normally operating rotor blades is also modeled in this analysis. A failure criterion based on the effective plastic strain in the region of impact is used to determine the failure of the containment ring due to impact. The results obtained in this study are compared with experimental tests results of a T58 gas turbine rotor performed at the spin chamber facility of the Naval Air Propulsion Test Center. The numerical computation is performed by using DYNA3D, an explicit, nonlinear finite element code for the simulation and analysis of large deformation dynamic responses of structures.

Derived from text

Gas Turbines; Dynamic Response; Fragments; Finite Element Method; Containment; Rotor Blades; Impact Damage; Computerized Simulation

19960051297 Pratt and Whitney Aircraft, West Palm Beach, FL USA

A New Approach to Tracking Turbine Engine Life

Hansen, John P., Pratt and Whitney Aircraft, USA; Paquet, Michel D., Pratt and Whitney Aircraft, USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 447-486; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This presentation describes a new approach to the monitoring and tracking of gas turbine engine life as it pertains to life-critical components. The approach is applicable to the modeling of common failure modes found in turbine engines today, including low cycle fatigue (LCF), crack growth, high cycle fatigue (HCF), oxidation/erosion, thermal mechanical fatigue, creep, and overload. The approach utilizing advanced life algorithms can be used for either day-to-day component life tracking, or to assist in the management of fleet assets in the event of a field problem. Although the technology exists to provide a large amount of life tracking data, current logistics/maintenance data management systems cannot effectively manage the multitude of life tracking parameters this approach is capable of providing.

Author

Algorithms; Gas Turbine Engines; Service Life; Life Cycle Costs; Logistics Management; Self Adaptive Control Systems; Real Time Operation; Engine Design

19960051438 National Aerospace Lab., Kakuda, Japan

Separated core turbofan engine

Saito, Yoshio, National Aerospace Lab., Japan; Endoh, Masanori, National Aerospace Lab., Japan; Matsuda, Yukio, National Aerospace Lab., Japan; Sugiyama, Nanahisa, National Aerospace Lab., Japan; Sugahara, Noboru, National Aerospace Lab., Japan; Yamamoto, Kazuomi, National Aerospace Lab., Japan; 1996; ISSN 0389-4010; 10p; In Japanese Report No.(s): NAL-TR-1289; UDC 621.45; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A new concept for a turbofan engine called the 'Separated Core Turbofan Engine' is proposed and studied under the research program of the ultrahigh bypass turbofan engine for the next generation high subsonic transport aircraft. The concept engine consists of two subunits, a core engine and a fan engine which are separate from each other. The results of the conceptual study show that this engine has many potential advantages over the current turbofan engines in many respects, including stability of operation and flexibility of configuration, and it also has other applications such as in advanced VTOL transport aircraft.

Author

Turbofan Engines; Subsonic Speed; Transport Aircraft; Vertical Takeoff Aircraft; Aircraft Engines

19960051459 National Aerospace Lab., Kakuda, Japan

Conceptual study of advanced VTOL transport aircraft engine

Saito, Yoshio, National Aerospace Lab., Japan; Endoh, Masanori, National Aerospace Lab., Japan; Matsuda, Yukio, National Aerospace Lab., Japan; Sugiyama, Nanahisa, National Aerospace Lab., Japan; Watanabe, Minoru, National Aerospace Lab., Japan; Sugahara, Noboru, National Aerospace Lab., Japan; Yamamoto, Kazuomi, National Aerospace Lab., Japan; 1996; ISSN 0389-4010; 10p; In Japanese

Report No.(s): NAL-TR-1290; UDC 621.45; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A new concept for a quiet engine for high subsonic VTOL transport aircraft is studied and presented. The concept engine, which is called the 'separated core turbofan engine', is effectively applied. It is composed of three core engines, two cruise fan engines and six lift fan engines. The cruise fan engines are optiniizeci for high subsonic cruise; the lift fan engines produce about 98kN (10000kgf) of thrust and can realize highly quiet operation. In this study, no technical prob-

lems have been found that are difficult to overcome for realizing this type of engine.
Author
Turbofan Engines; Lift Fans; Subsonic Speed; Vertical Takeoff Aircraft

19960052324 Lockheed Martin Tactical Aircraft Systems, Fort Worth, TX USA
A CFD Study of Turbojet and Single-Throat Ramjet Ejector Interaction
Chang, Ing, Prairie View Agricultural and Mechanical Coll., USA; Hunter, Louis, Lockheed Martin Tactical Aircraft Systems, USA; HBCUs Research Conference Agenda and Abstracts; Jul. 1996, pp. 39; In English; Also announced as 19960052296
Report No.(s): Paper-28; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Abstract Only; Abstract Only

Supersonic ejector-diffuse systems have application in driving an advanced airbreathing propulsion system, consisting of turbojet engines acting as the primary and a single throat ramjet acting as the secondary. The turbojet engines are integrated into the single throat ramjet to minimize variable geometry and eliminate redundant propulsion components. The result is a simple, lightweight system that is operable from takeoff to high Mach numbers. At this high Mach number (approximately Mach 3.0), the turbojets are turned off and the high speed ramjet/scramjet take over and drive the vehicle to Mach 6.0. The turbojet-ejector-ramjet system consists of nonafterburning turbojet engines with ducting canted at 20 degrees to supply supersonic flow (downstream of CD nozzle) to the horizontal ramjet duct at a supply total pressure and temperature. Two conditions were modelled by a 2-D full Navier Stokes code at Mach 2.0. The code modelled the Fabri choke as well as the non-Fabri non critical case, using a computational throat to supply the back pressure. The results, which primarily predict the secondary mass flow rate and the mixed conditions at the ejector exit were in reasonable agreement with the 1-D cycle code (TBCC).
Author (revised)
Computational Fluid Dynamics; Turbojet Engines; Ramjet Engines; Ejectors

19960052719 Office National d'Etudes et de Recherches Aerospatiales, Paris, France
A numerical simulation of film cooling: Basic phenomena and application to gas turbine blade thermal protection
Etude numerique du refroidissement par film: Phenomenes de base et application a la protection thermique des aubes de turbines
Duchene, Christophe, Office National d'Etudes et de Recherches Aerospatiales, France; 1996; 280p; In French; Original contains color illustrations; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

This study deals with turbine blades film cooling. Numerical simulation allowed us a detailed study of interaction phenomena of cooling jets in crossflow. to do this, the three dimensional compressible and turbulent global equations are integrated over meshes which consist of structured subdomains. The first part of this work presents the numerical method: numerical schemes, turbulence and wall exchanges modeling. We thereafter attempt to analyze the film cooling process in an increasingly complex framework. At first interaction of a single jet with a boundary layer over a flat plate is investigated. It allowed to carry out a detailed analysis of the emission zone and to identify the induced vortices. After defining the heat transfer coefficient, the most relevant parameters concerning cooling efficiency are also identified. Next we consider the case where a row of holes contributes to the cooling process and we introduce an analytical model describing the vortex induction phenomenon. In order to apply this work to more realistic situations we describe the influence of inertial effects on cooling performance. In this respect, the acceleration of the main flow, the wall curvature and the rotation are individually studied. We then go on to apply the above numerical work to a turbine blade. Comparison between numerical and experimental data shows satisfactory agreement. We conclude by summarizing our work and suggesting future work.
Author
Boundary Layers; Film Cooling; Gas Turbines; Heat Transfer Coefficients; Hole Distribution (Mechanics); Holes (Mechanics); Turbulence Models

19960053289 Naval Postgraduate School, Monterey, CA USA
Unmanned Aerial Vehicles: A Study of Gas Turbine Application
Lobik, David P., Naval Postgraduate School, USA; Sep. 1995; 89p; In English
Report No.(s): AD-A306678; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A survey of commercially-available gas turbine, spark and compression ignition engines was conducted to evaluate their current and future relative suitability for the DoD's unmanned aerial vehicle (UAV) short and close range program. The effects on performance associated with reducing gas turbine engine size from full scale to UAV dimensions were examined. A small turbo-jet engine (produced in France for remotely piloted vehicles) was procured in order to evaluate what levels of performance, power and endurance potential are currently achieved in commercially-available small engines. An engine test rig was designed and built to conduct performance tests. The engine was installed, instrumented and operated successfully through a series of five to eight minute tests. Selected measurements form the test stand were entered into an engine performance code in order to establish what component efficiencies and cycle parameters were

required for the code to output the measured values of specific thrust and specific fuel consumption. With realistic component efficiencies thus determined, they could be used to compare gas turbine engine performance with that of other small-scale propulsion systems.
DTIC
Gas Turbine Engines; Internal Combustion Engines; Surveys; Propulsion System Performance; Pilotless Aircraft; Engine Design; Engine Tests; Efficiency; Performance Tests; Remotely Piloted Vehicles

19960054418 Advisory Group for Aerospace Research and Development, Propulsion and Energetics Panel, Neuilly-Sur-Seine, France
Advanced Aero-Engine Concepts and Controls ***Les Concepts Avances et Les Commandes des Nouveaux Moteurs d'Avion***
Jun. 1996; 428p; In English; In French, 25-29 Sep. 1995, Seattle, WA, USA; Sponsored by Advisory Group for Aerospace Research and Development, France; Also announced as 19960054419 through 19960054454
Report No.(s): AGARD-CP-572; ISBN-92-836-0025-8; Copyright Waived; Avail: CASI; A19, Hardcopy; A04, Microfiche

The Propulsion and Energetics Panel Symposium on Advanced Aero-Engine Concepts and Controls was held from 25-29 September 1995 in Seattle, Washington, USA. It dealt with propulsion, including thrust vectoring, for future combat aircraft, vertical landing aircraft and transport aircraft. Better fuel efficiency, longer range and higher operational flexibility will be gained from aero engines with advanced cycles which require improvements in fluid dynamics, materials and cooling. Five Sessions (37 papers including the keynote): Engine research and demonstration, requirements and programmes (3); Aircraft engine integration (5); Propulsion system and component technology (IO); Engine control systems (I 3); Integrated flight and propulsion control (5). Dual use application of results is intended.
Author
Aircraft Engines; Conferences; Engine Control; Thrust Vector Control; Propulsion System Configurations; Propulsion System Performance; Engine Airframe Integration; Inlet Airframe Configurations; Engine Design; Control Systems Design

19960054419 Wright Lab., Turbine Engine Div., Wright-Patterson AFB, OH USA
The Purpose and Status of IHPTET: 1995
Hill, Richard J., Wright Lab., USA; Advanced Aero-Engine Concepts and Controls; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper discusses the purposes (background, goals, and applications) and the status of the Integrated High Performance Turbine Engine Technology (IHPTET) program through July 1995. IHPTET is a coordinated, three phase, government and industry sponsored propulsion program. It includes virtually all government and industry sponsored research and development (R&D) activities devoted to advancing technology for military turbine engines.
Derived from text
Aircraft Engines; Engine Design; Gas Turbine Engines; Government/Industry Relations

19960054420 Ministry of Defence, Directorate of Future Systems (Air), London, UK
Future Technology Requirements for UK Combat Engines
Paramour, M. D., Ministry of Defence, UK; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper reviews the future requirements of the UK Services for combat engines, and discusses the design considerations and technology that will be required to meet them. Emphasis is placed on the need for improved reliability and maintainability and reduced life-cycle costs, as well as improved performance. Current and proposed technology demonstrator programs, to be undertaken both nationally and in collaboration with other nations, to ensure that the technology will be available, are described.
Author
Cost Reduction; Life Cycle Costs; Engine Design; Technology Utilization; Military Aircraft; STOVL Aircraft

19960054421 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Future Technologies for Military Engines, Moissy-Cramayel, France
Acquision and Demonstration of Technologies for Future Military Engines: The AMET Progrm ***Acquision et Demonstration des Technologies pour Futurs Moteurs Militaires: Le Programme AMET***
Dufau, Jacques, Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Jun. 1996; 8p; In French; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Requirements for a high performance weapons system that go beyond aeronautical programs already underway, among which are the Eurofighter 2000, the Rafale, and the F-22, are leading to constant study on aspects for improvements to the quality of the carrier aircraft such as: the air frame, armament system, engine system, and integration. In addition to the simple set of rough performance features, it will also be necessary to manage the ownership cost (life-cycle costs) of these new systems. Progress made by engine developers is traditionally measured by means of; the thrust to weight ratio of the propulsion system, the specific consumption (at full speed and at partial modes during supersonic or subsonic cruising) of the turbojet engine, discretion (radar

electromagnetic signature and emissions radiating in the infrared range), acquisition and use cost of the equipment. A program to improve the characteristics mentioned above has already begun. It is the advanced military engine technology (AMET) program.
Author
Life Cycle Costs; Military Technology; Turbojet Engines; Engine Design; Radar Signatures; Technology Utilization

19960054422 Defence Research Agency, Pyestock, UK
The Impact of Advanced Engine Technology on Combat Aircraft Performance
Hodder, S. D., Defence Research Agency, UK; Simm, S. E., Defence Research Agency, UK; Advanced Aero-Engine Concepts and Controls; Jun. 1996; 20p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper examines how advanced engine technology can affect the design and performance of an air-to-air combat aircraft optimized for typical combat air patrol and intercept missions. The impact of cycle temperatures, component efficiencies, cooling effectiveness and engine thrust-weight ratio are studied independently to assess the relative benefits of each aspect of engine technology. Both fixed and variable cycles are considered, enabling the contributions of advanced technology and of cycle variability to be separated.
Author
Aircraft Performance; Fighter Aircraft; Thrust-Weight Ratio; Engine Design; Technology Utilization; Military Technology

19960054423 Rolls-Royce Ltd., Bristol, UK
Advanced Combat Engines: Tailoring the Thrust to the Critical Flight Regimes
Garwood, K. R., Rolls-Royce Ltd., UK; Round, P., Rolls-Royce Ltd., UK; Hodges, G. S., Rolls-Royce Ltd., UK; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Future combat engines will operate at higher turbine temperatures and overall pressure ratios, which will enable high specific thrusts and good low power specific fuel consumption to be realized. The application of these technologies into aircraft needs to address the weapons platform requirements of agility, range, combat persistence. The influence of engine rating schemes and aircraft performance requirements are discussed with indications that higher specific thrust engines will be required for increase force projection.
Author
Aircraft Performance; Thrust-Weight Ratio; Engine Design; Weapon Systems; Military Technology; Technology Utilization

19960054424 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn, Germany
The STRATO 2C Propulsion System: A New Compound Engine and Control Concept for High Altitude Flying
Toenskoetter, H., Industrieanlagen-Betriebsgesellschaft m.b.H., Germany; Scheithauer, D., Industrieanlagen-Betriebsgesellschaft m.b.H., Germany; Jun. 1996; 14p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The propulsion system for the STRATO 2C high altitude long endurance (HALE) aircraft is an example of the development of a power plant that is tailored to a special unconventional usage and even takes advantage of the reliability and low cost of available components as well as the advanced technology of turbine engines. The disadvantages of a compromise in the optimization of the propulsion system did not jeopardize the overall design philosophy. The task of designing a low risk, low cost control system was achieved by: a conventional certified engine control system, and a new digital control system for matching the turbocharger stages under steady state and transient operating conditions for cooling flow control and for rotor speed and manifold pressure limitations.
Author
Control Systems Design; Engine Control; Engine Design; Turbine Engines; Financial Management; Digital Techniques; Computer Aided Design; Propulsion System Performance

19960054425 Wright Lab., Aero Propulsion and Power Directorate, Wright-Patterson AFB, OH USA
Propulsion Considerations for an Advanced Vertical Take-Off and Landing (VTOL) Transport Aircraft
Norden, Christopher M., Wright Lab., USA; Stricker, Jeffrey M., Wright Lab., USA; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The objective of this paper is to demonstrate the benefits and challenges of advanced propulsion system technologies on a vertical take-off and landing (VTOL) transport aircraft. The study concentrates on two types of propulsion concepts: mechanical and gas driven configurations. Both use turbofans for cruise and lift fans for vertical operations. A conceptual design analysis for the propulsion components is presented. Unique propulsion design characteristics associated with VTOL aircraft are discussed as well. These include sizing, hover, and operational constraints.
Derived from text
Design Analysis; Engine Parts; Aircraft Design; Transport Aircraft; Turbofans; Engine Design; Lift Fans

19960054426 Rolls-Royce Ltd., Bristol, UK
Powerplants and Lift Systems for ASTROVL Aircraft: The Challenges to an Engine Maker

Pearson, David M., Rolls-Royce Ltd., UK; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper discusses the design requirements and major challenges associated with powerplants for short take-off and vertical landing (STOVL) capable aircraft currently being studied under the Joint Advanced Strike Technology (JAST) program. Challenges specific to four different lift system concepts are described, namely: direct lift, shaft driven fan, gas driven fan, and lift plus lift cruise. Generic issues that must be resolved for any of these powerplants, namely: exhaust design, attitude control provision, reliability and affordability, are also discussed. All of the proposed concepts present significant challenges to the engine maker, particularly if the powerplant is to be used in a conventional take-off and landing (CTOL)/STOVL aircraft as proposed for the JAST program.

Author

STOVL Aircraft; Lift Fans; Aircraft Design; Engine Design; Propulsion System Configurations; Cost Effectiveness

19960054427 Wright Lab., Wright-Patterson AFB, OH USA

Developing Affordable Gas Turbine Engines

Skira, Charles A., Wright Lab., USA; Jun. 1996; 8p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The costs of advanced high performance gas turbine engines for future military fighter aircraft applications are explored. The impact of increasing engine performance on the cost of the aircraft was examined and it was found to have a favorable impact on the cost of the weapon system. From an engine viewpoint, advanced component performance and improved cost effective manufacturing methods combine to significantly lower the cost of gas turbine engines on a per pound of thrust basis. Engine component costs were compared and analyzed for a modern fielded engine and an advanced technology, high performance engine. Manufacturing costs and the implication to overall engine cost reduction for advanced technology engines were explored.

Author

Component Reliability; Cost Effectiveness; Cost Reduction; Engine Parts; Gas Turbine Engines; Engine Design; Propulsion System Performance; Service Life

19960054428 Sundstrand Turbomach, San Diego, CA USA

Advanced Small Turbopropulsion Engines

Rodgers, Colin, Sundstrand Turbomach, USA; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Candidate advanced turbopropulsion engines to fulfill the requirements for the next generation military small aircraft, drones, and missiles are: turbojets, turboprops, turbofans, air turbo-ramjets, pulsejets, and combinations thereof. Prime requirements are to provide significant range increases with high flight Mach numbers and, in some applications, extended endurance above the tropopause, both of which are primarily dependent upon propulsion system specific fuel consumption trends. Other combinations of turbojets, rockets and ramjets are being studied for operation at even higher Mach numbers, but generally involve variable geometry inlets and exhausts difficult to incorporate on small propulsion vehicles. Preliminary design studies of a variety of advanced small turbopropulsion concepts was conducted recently by the author and associates, including: small stoichiometric air-turbo-ramjets, high pressure ration intercooled turboprop, semi-constant volume turbojet, regenerative feedback turbine engine. This paper compiles the results of these studies and highlights the design features necessary to attain advanced levels of performance.

Author

Engine Design; Fuel Consumption; Propulsion System Configurations; Military Aircraft; Tropopause; Flight Altitude; Range (Extremes)

19960054429 Alfa Romeo S.p.A., Propulsion and Aerothermodynamics, Naples, Italy

Preliminary Design and Performance Analysis of a Variable Geometry Recuperative Turboshaft

Colantuoni, S., Alfa Romeo S.p.A., Italy; Colella, A., Alfa Romeo S.p.A., Italy; Mainiero, G., Alfa Romeo S.p.A., Italy; Santoriello, G., Alfa Romeo S.p.A., Italy; Cirillo. L., Alfa Romeo S.p.A., Italy; Iossa, C., Alfa Romeo S.p.A., Italy; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper describes a performance study of a compact turboshaft engine based on two concepts that can contribute to the performance gains of advanced future propulsion systems: the recuperative cycle and the variable geometry. Cycle optimization is done for a medium helicopter application, minimizing the fuel consumption and taking into account moderate levels of peak gas temperature to guarantee adequate life of the most critical engine hot components. The engine architecture (1000 kW class turboshaft with free turbine) is based on a minimum number of turbomachinery components to reduce the weight of the propulsion system and its global cost (initial and operative). The three gas generator components are: (1) a transonic, high performance, 8 to 1 pressure ratio single stage centrifugal compressor; (2) a very compact, reverse flow, annular flame tube, having a 1600 K combustor exit temperature; (3) a high-loaded, cooled axial flow turbine stage. The variable geometry free-power turbine is counter rotating with respect to the gas-generator rotor and the power output is available at the rear-end of the engine. A heat exchanger recuperator, placed behind the power turbine, contributes to a significant reduction of the engine specific fuel consumption. The components of the engine gas-generator section are based on the results of company research pro-

jects in the application of the most advanced computational fluid dynamics (CFD) techniques for the aero-thermal design of turbomachinery and combustors.
Author
Axial Flow Turbines; Combustion Chambers; Engine Design; Engine Parts; Fuel Consumption; Gas Temperature; Variable Geometry Structures; Turboshafts; Heat Exchangers

19960054430 General Electric Co., Aircraft Engines, Cincinnati, OH USA
Variable Cycle Engine Concepts
Johnson, J. E., General Electric Co., USA; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper describes several of the concepts evaluated during the last three decades, starting with the Air Force defined variable pumping compressor (VAPCOM) and concluding with a general discription of the YF120 variable cycle engine (VCE) that flew in the YF-22 and YF-23 advanced tactical fighter (ATF) prototype aircraft. Section 1.3 describes the final evolution of the F120 type VCE and section 1.4 briefly addresses the current status of VCE development. These development activities lead to an affordable engine that combines the attributes of a high turbine turbojet, i.e. high dry specific thrust and low maximum power specific fuel consumption, with those of a turbofan, i.e., low partial power specific fuel consumption with low gas exhaust temperatures.
Derived from text
Turbojet Engines; Turbofan Engines; Variable Cycle Engines; Engine Design; Propulsion System Performance; Cost Effectiveness

19960054431 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Antriebtechnik, Cologne, Germany
Studies on NOx-Emissions of SST Engine Concepts
Deidewig, F., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Doepelheuer, A., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Jun. 1996; 14p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

To predict the engine performance at subsonic and supersonic design and off-design flight conditions a thermodynamical calculation procedure has been developed that describes the engine performance with the help of generalized turbine and nozzle characteristics. to demonstrate the advantages of new engine concepts, including variable cycle and/or intercooler, on an aircraft with a payload of about 10,000 kg a realistic flight trajectory has been chosen, which involves every phase along the entire flight path: take-off, climb, supersonic acceleration, cruise, and descent. The results for the chosen flight routes, including fuel flow rates and NO2 emissions, are compared to a zero-bypass engine, the Olympus 593 Mk610, producing comparable thrust.
Author
Flight Paths; Fuel Consumption; Nitrogen Oxides; Turbofan Engines; Engine Design; Thermodynamics; Variable Cycle Engines; Propulsion System Performance; Combustion Efficiency

19960054432 Royal Military Academy, Dept. of Applied Mechanics, Brussels, Belgium
Scramjet Performance Analysis as a Function of Combustion Process Parameters *Analyse des Performances d'un Superstatoreacteur en Fonction des Parametres de Combustion*
Hendrick, P., Royal Military Academy, Belgium; Jun. 1996; 10p; In French; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

With a single stage to orbit (SSTO) engine using aerobic propulsion, a considerable gain in the useful load fraction can be obtained only if one reaches at least Mach 14-15 in the aerobic mode. In order to reach this performance level, the use of a scramjet engine with hydrogen fuel is mandatory. This study five analytical results of the sensitivity of performance parameters of a scramjet engine called the Hyperjet Mk.3 (projecting part, external ramp with three segments, supersonic diffuser, insulator, combustion chamber, and internal and external ejection nozzles) that uses hydrogen slush as the stored fuel. Furthermore, it uses active cooling of the airframe walls and of the engine to reheat the fuel after injection. This study was conducted at Mach 15 with a dynamic pressure of 60 kPa and constant total angle of incidence equal to 11 degrees. The code used is an aerothermodynamic code 1.5-D with viscous effects in which the air is considered as the mixture (with nine ingredients) of perfect gases that chemically react with one another.
Author
Aerothermodynamics; Combustion Chambers; Slush Hydrogen; Supersonic Combustion Ramjet Engines; Supersonic Diffusers; Fuel Injection; Propulsion System Performance

19960054433 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany
Combined-Cycle Engines for Hypersonic Applications
Heitmeir, F. J., Motoren- und Turbinen-Union G.m.b.H., Germany; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper highlights the technological challenges associated with combined-cycle engines for hypersonic flight (Mach 0 to Mach 7). At first, different possible engine concepts are discussed. Selection criteria such as operating requirements and other boundary conditions are used to narrow down the number of concepts. Furthermore, the techno-

logical challenges associated with combined-cycle engines are presented with respect to the selected baseline engine.
Derived from text
Engine Design; Hypersonic Flight; Propulsion System Performance; Hybrid Propulsion; Engine Parts; Combustion Chambers; Air Breathing Engines

19960054434 Technische Univ., Lehrstuhl fuer Flugantiebe, Munich, Germany
Design and Off-Design Simulation of Highly Integrated Hypersonic Propulsion Systems
Esch, Th., Technische Univ., Germany; Hollmeier, S., Technische Univ., Germany; Rick, H., Technische Univ., Ger–many; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The propulsion system for the lower stage of a two-stage-to-orbit transport system (TSTO) is presented with its main components: mixed compression air inlet, combustion chamber, and single expansion ramp nozzle (SERN). Using an implicit finite-volume Navier-Stokes code the flow fields in these components are studied. Comparisons between experimental data and computational fluid dynamics (CFD) calculations are presented for a two-dimensional high speed inlet, a high temperature reacting three-dimensional combustion chamber flow, and a two-dimensional nozzle/afterbody flow field. to determine the forces and moments acting on the propulsion system, comprehensive studies were performed from transonic to hypersonic flight Mach numbers. The results of these studies form the basis for an accurate description of performance and operating behavior of the propulsion system by performance analysis. At hypersonic speeds the effects of the propulsion system on flight-mechanical behavior is substantial, especially in the event of engine failures. Two failure scenarios were considered: flame out and inlet choking. For both cases, the forces acting on the propulsion system are shown.
Author
Navier-Stokes Equation; Propulsion System Performance; Computational Fluid Dynamics; Engine Failure; Finite Volume Method; Flow Distribution; Hypersonic Flow; Transonic Flight

19960054435 Technische Hochschule, Inst. fuer Luftfahrtantriebe, Stuttgart, Germany
Performance Optimization of a Turboramjet Engine for Hypersonic Flight
Bareis, B., Technische Hochschule, Germany; Braig, W., Technische Hochschule, Germany; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

A turbo-ramjet engine is investigated for the acceleration flight mission of the the lower stage of a two stage space transportation system. The method described in this paper allows for the optimization of the engine control parameters in parallel to the engine performance calculations. For a turbo-ramjet engine, the results of the optimization for an ascent flight mission was well as for the transition from turbo to ram operation are presented. The results show a strong, highly nonlinear sensitivity of thrust and fuel flow to the flight conditions and engine control parameter settings.
Derived from text
Engine Control; Hypersonic Flight; Turboramjet Engines; Fuel Flow; Optimization; Propulsion System Performance; Engine Design

19960054436 Technische Hochschule, Inst. fuer Strahlantriebe und Turboarbeitsmaschinen, Aachen, Germany
Application of a System for the Monitoring of Aerodynamic Load and Stall in Multi-Stage Axial Compressors
Hoenen, H., Technische Hochschule, Germany; Gallus, H. E., Technische Hochschule, Germany; Advanced Aero-Engine Concepts and Controls; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

As part of a complete health monitoring system, the observation of aerodynamic compressor load and the detection of stall in multi stage axial compressors is explained in detail. First, the definition of monitoring parameters and the choice of a suitable measuring technique is demonstrated. Based on the design of the system structure, the hardware and software solution is shown. Checking modules and a failure detection mode for all components makes up a large part of the software. With the help of suitable input and output interfaces the system can be adjusted for various applications and the monitoring results can be made visible. Furthermore, the experiences with this system as applied to three multi-stage compressors are reported. The behavior of the monitoring parameters shows a good agreement with the different operating conditions of the compressor as well as for design conditions and operation near the stability limit.
Author
Turbocompressors; Aerodynamic Loads; Failure Modes; Systems Health Monitoring; Propulsion System Performance; Aerodynamic Stalling; Gas Turbine Engines

19960054437 Deutsche Aerospace A.G., Military Aircraft, Munich, Germany
Application of Thrust Vectoring to Future Aircraft Design
Ross, Hannes, Deutsche Aerospace A.G., Germany; Huber, Peter, Deutsche Aerospace A.G., Germany; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper reports on studies and flight test results of the X-31 aircraft demonstrating the effective utilization of thrust vectoring within the conventional and expanded (into the post-stall regime) flight envelope. It addresses also new

design options provided by thrust vectoring, in particular, the option to reduce the vertical tail surface.
Author
Aircraft Design; Flight Envelopes; Thrust Vector Control; Tail Surfaces; Aerodynamic Stability; Aircraft Control; Thrust-Weight Ratio

19960054438 Pratt and Whitney Aircraft, West Palm Beach, FL USA
The F-15 Active Aircraft: The Next Step
Bursey, Roger, Pratt and Whitney Aircraft, USA; Jun. 1996; 6p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

As the aerospace industry adjusts to post cold-war budgets, emphasis is shifting rapidly to demonstrating technologies of the future with modern-day fighters before committing them to production. Pratt and Whitney, together with NASA Dryden, US Air Force Wright Laboratories, and McDonnell-Douglas have developed such a system based on the F-15. This testbed aircraft has the capability to demonstrate a wide array of aerodynamic and propulsion integration technologies that will apply to future commercial and military aircraft design. This paper presents the ways and means of how Pratt and Whitney designed, manufactured, and flight tested affordable axisymmetric exhaust nozzles incorporating multi-directional thrust vectoring for the Advanced Control Technology for Integrated Vehicles (ACTIVE) program.
Author
Aircraft Design; Thrust Vector Control; F-15 Aircraft; Flight Tests; Exhaust Nozzles; Research Aircraft

19960054439 Sener Ingenieria y Sistemas S.A., Madrid, Spain
Optimization of Actuation and Cooling Systems for Advanced Convergent-Divergent Nozzles of Combat Aircraft
Sanchez-Tarifa, C., Sener Ingenieria y Sistemas S.A., Spain; Rodriguez-Fernandez, M., Sener Ingenieria y Sistemas S.A., Spain; Rebolo, R., Sener Ingenieria y Sistemas S.A., Spain; Corchero, G., Sener Ingenieria y Sistemas S.A., Spain; Rodriguez-Martin, M., Industria de Turbo Propulsores S.A., Spain; UlizarAlvarez, I., Industria de Turbo Propulsores S.A., Spain; Jun. 1996; 8p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The system or components of a convergent-divergent (CON-DI) nozzle that offer better perspectives for improvement and optimization are the actuation and cooling systems. Performance offers little margin for a direct improvement, and the utilization of advanced materials in many components of the nozzle present no specific problems as compared with those of other parts of the engine, with the exception of the petals, in which the introduction of ceramic materials has a direct influence on cooling and performance, and it is included in the cooling optimization. The problem of optimization of the actuation system was discussed earlier, mainly in connection with the utilization of a one versus two parameter actuation system. Since that time SENDER and ITP have carried out many studies and tests on actuation systems and on cooling optimization. They also have accumulated experience by means of theoretical and experimental studies on the utilization of ceramic petals. Some results and the main conclusion of these studies and tests are presented in this paper.
Author
Convergent-Divergent Nozzles; Cooling Systems; Actuators; Optimization; Nozzle Geometry; Ceramic Matrix Composites

19960054440 Societe Nationale d'Etudes et de Construction de Moteurs Aeronautiques, Control and Accessories Div., Moissy-Cramayel, France
An Advanced Control System for Turbofan Engine: Multivariable Control and Fuzzy Logic (Application to the M88-2 Engine)
Garassino, Alain, Societe Nationale d'Etudes et de Construction de Moteurs Aeronautiques, France; Bois, Patrick, Societe Nationale d'Etudes et de Construction de Moteurs Aeronautiques, France; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The search for better performance of present and future turbofan engines involves an increase in the number of variable geometries and thus of control loops. As we can not, or do not, want to disregard the interaction between loops any more, the future control systems will therefore be multivariable. The aim of the architecture of multivariable control presented here is to optimize a performance index during transients. This architecture consists of an inner loop which optimizes the performance index taking into account the limitations, an outer loop which brings the nominal steady-state offsets to zero, and a trajectory that takes into account the topping schedule limitation. This basic architecture can be improved by a fuzzy supervisor. Indeed, two control outputs are generated according to the description mentioned above. The first one optimizes the thrust and does not care very much about the low pressure stall (LPS) margin limitation. The second one optimizes again the thrust and strongly takes the LPS margin limitation into account. The fuzzy logic then provides for a compromise between these two control outputs according to the engine state. Simulation results showing the efficiency of the method are presented.
Author
Fuzzy Systems; Multivariable Control; Turbofan Engines; Aerodynamic Stalling; Linear Quadratic Regulator; Control Systems Design; Optimal Control; Thrust Control

19960054441 Defence Research Agency, Propuslion Technology Dept., Farnborough, UK
Multivariable Control of Military Engines

Dadd, G. J., Defence Research Agency, UK; Sutton, A. E., Defence Research Agency, UK; Greig, A. W. M., Defence Research Agency, UK; Advanced Aero-Engine Concepts and Controls; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper reviews research into the multivariable control (MVC) of aircraft powerplants; illustrating that MVC offers a potential for tighter and more responsive control of conventional aircraft engine operations. Tools and methods have been established to support technical demonstrations of flight capable multivariate controls in variable cycle engine (VCE) and advanced short take-off and and vertical landing (ASTOVL) propulsion systems.

Derived from text

Aircraft Engines; V/STOL Aircraft; Variable Cycle Engines; Propulsion System Performance; Multivariable Control; Control Systems Design; Aircraft Control

19960054442 Turbomeca S.A. - Brevets Szydlowski, Microturbo Div., Bordes, France

Advanced Control System for a Turbine Engine ***Systeme de Regulation Avance pour Turbomoteur***

Frealle, J. L., Turbomeca S.A. - Brevets Szydlowski, France; Jun. 1996; 14p; In French; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The appearance of full authority digital electronic control (FADEC)-type regulations for helicopter turbine engines in recent years has considerably enriched the engine control function. Helicopter usage has been made easier and the pilot's workload reduced, with the engine and power transmission train being automatically maintained within their limits. Maneuverability of the helicopter has been improved by rotor speed regulation performance features. The opportunity for strict management of engine emergency operating conditions, greatly superior to continuous maximum conditions, has led to considerable improvements in the performance parameters of two-engine helicopters in one engine inoperative (OEI) situations. Functions that will help in pilot training for this breakdown configuration are integrated into the control functions.

AIP

Emergencies; Engine Control; Helicopter Engines; Gas Turbine Engines; Control Systems Design; Rotor Speed; Speed Control

19960054443 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Engineering Div., Moissy-Cramayel, France

Contribution of Dynamic Engine Simulation to Military Turbofan Control System Design and Development

Pierre, Laurent, Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Duponchel, Jean-Pierre, Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Gerard, Pierre, Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper describes dynamic simulations of transient performances applicable to modern military engines. This document is dedicated to the diverse tasks conducted regarding dynamic engine behavior control that are to be solved using an analytical process that relies on dynamic simulations of the engine and its systems. The main features of the engine transient model, its real-time version, and the identification tools that ensure evolution of the features are presented. Some applications are: the interpretation of tests (determination of in-situ compressor surge line position, analysis of engine response during flight testing, etc.); the design of control laws (effect of dynamics of a given element on the engine response, assessment of the response of the most critical engine).

Derived from text

Control Systems Design; Turbofan Engines; Engine Control; Dynamic Control; Real Time Operation; Computerized Simulation; Propulsion System Performance

19960054444 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Control and Accessories Div., Moissy-Cramayel, France

Neural Adaptive Control of an Engine Exhaust Nozzle

Garassino, Alain, Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Advanced Aero-Engine Concepts and Controls; Jun. 1996; 8p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This work deals with the application of neural techniques to control a turbofan engine exhaust nozzle area. The process exhibits strong non-linearities and thus it is difficult to control with classical methods. Neural networks are used with an approach inspired by indirect adaptive control. The neural controller consists of two neural networks which communicate with each other. One achieves the identification task while the other controls the nozzle area. The simulation results of the process with a neural controller are given and compared with current results. The neural controller is better than the classical one and leads to a significant improvement in engine performance. Furthermore, the method can be used easily to control any non-linear dynamic system.

Author

Adaptive Control; Turbofan Engines; Exhaust Nozzles; Neural Nets; Control Systems Design

19960054445 Army Research Lab., Vehicle Propulsion Direcorate, Cleveland, OH USA

Adaptive Optimization of Aircraft Engine Performance Using Neural Networks

Simon, Donald L., Army Research Lab., USA; Long, Theresa

W., NeuroDyne, Inc., USA; Jun. 1996; 14p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Preliminary results are presented on the development of an adaptive neural network based control algorithm to enhance aircraft engine performance. This work builds upon a previous NASA effort known as performance seeking control (PSC), an adaptive control algorithm that contains a model of the aircraft propulsion system which is updated on-line to match the operation of the aircraft's actual propulsion system. The neural network based adaptive control, like PSC, will contain a model of the propulsion system that will be used to calculate optimal control commands on-line. It is hoped that it will be able to provide some additional benefits above that provided by PSC. Since the PSC algorithm is computationally intensive, it is valid only at near steady-state flight conditions and has no way to adapt or learn on-line, these issues are being addressed in the development of the optimal neural controller. Specialized neural network processing hardware is being developed to run the software. The algorithm will be valid at steady-state and transient conditions, and will take advantage of the on-line learning capability of neural networks. Future plans call for the testing of the neural network software and hardware prototype against an aircraft engine simulation.

Author

Adaptive Control; Aircraft Engines; Algorithms; Network Control; Neural Nets; Control Systems Design; Propulsion System Performance

19960054446 Wright Lab., Wright-Patterson AFB, OH USA

Distributed Architectures for Advanced Engine Control Systems

Lewis, T. J., Wright Lab., USA; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The goals of the Integrated High Performance Turbine Engine Technology (IHPTET) initiative demand that controls and accessories (C/A) weight, acquisition cost, and support cost be significantly reduced for modern gas turbine engines. Distributed control technology is one of the few approaches that has the potential to effect reductions in all three categories. Weight can be reduced by replacing the traditionally complex full authority digital electronic control (FADEC) and heavy harness assembly with light-weight distributed processing elements interconnected via a simple communication and power distributing bus. Simplification of FADEC interfaces makes off-engine mounting feasible, enabling an acquisition cost reduction that is greater than the cost increase incurred by adding electronics to engine sensors and actuators. Distributing intelligence throughout the engine will improve the control system's ability to isolate faults. The resulting reductions in time to troubleshoot and unnecessary component removals will decrease maintenance costs. Since high temperature electronics are the key to the viability of the distributed control concept, recent developments in this area are reviewed.

Author

Aircraft Engines; Active Control; Engine Control; Engine Design; Gas Turbine Engines; Cost Reduction; Distributed Parameter Systems; Electronic Control

19960054447 Fiat Aviazione S.p.A., Control Design, Turin, Italy

Safety Critical Software Development for Advanced Full Authority Control Systems

Tortarolo, Franco, Fiat Aviazione S.p.A., Italy; Crosetti, Guido, Fiat Aviazione S.p.A., Italy; Difilippo, Carmine, Fiat Aviazione S.p.A., Italy; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper focuses on the experience gained during the specification and development of the system development environment and its subsequent use for the safety critical software for the European Fighter aircraft engine (EJ2000) fully automated digital electronic controls (FADECs) where performance, reliability, testability, and maintainability have equal priority. It concentrates on the methodologies and tools employed during each software development phase with particular emphasis on safety related techniques.

Author

Fighter Aircraft; Engine Design; Computer Aided Design; Electronic Control; Safety Factors; Propulsion System Performance; Control Systems Design; Specifications; Standards

19960054448 Pratt and Whitney Aircraft, Government Engines and Space Propulsion, West Palm Beach, FL USA

Review of Photonic System Development for Propulsion Controls

Birdsall, J. C., Pratt and Whitney Aircraft, USA; Fields, C. V., Pratt and Whitney Aircraft, USA; Agnello, M., Naval Air Warfare Center, USA; Jun. 1996; 6p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The use of photonics on aircraft gas turbine engines offers weight savings, electromagnetic interference (EMI) immunity, and performance benefits for engine control systems. For these reasons, fly-by-light technology is being developed for use in future aircraft control systems. Full authority digital electronic control (FADEC) systems that are compatible with fly-by-light aircraft and that use fiber optics on the engine for sensing and control are under development at United Technologies Corporation. Pratt and Whitney has made progress in transitioning fiber optics sensors, harnesses and optro-electronic FADEC (OEF) interfaces to engine demonstration programs. This paper discusses the benefits of photonic propulsion control systems, describes the components

of an opto-electronic engine control system, provides results from on-engine testing, presents lessons learned and discusses areas that require additional development to achieve technology readiness for product transition.
Author
Aircraft Engines; Gas Turbine Engines; Engine Control; Fly by Light Control; Interference Immunity; Photonics; Electronic Control

19960054449 Institute for Aerospace Research, Structures, Materials and Propulsion Lab., Ottawa, Ontario Canada
Modelling of a Fuel Control Unit for Small Gas Turbine Engines Featuring Interacting Electronic Linear Actuators
Georgantas, A. I., Institute for Aerospace Research, Canada; Krepec, T., Concordia Univ., Canada; Cheng, R. M. H., Concordia Univ., Canada; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper investigates an electic fuel control unit for small gas turbine engines, with valves operated by linear digital actuators. The unit is based on the modified metering section of a conventional hydromechanical fuel control unit. A mathematical model of the system is first developed and validated by experimentation. It is subsequently used for simulation and further study of the system dynamics. It was demonstrated that this new system features greater functional flexibility and faster transient response than the conventional system. The possibility for back-up, in case of failure of one valve also is discussed.
Author
Gas Turbine Engines; Transient Response; Actuators; Control Equipment; Engine Design; Fuel Control; Fuel Valves; Engine Failure

19960054450 Defence Research Agency, Flight Dynamics and Simulation Dept., Bedford, UK
The VAAC Harrier Programme: Flying STOVL With 1-Inceptor Control
Shanks, G. T., Defence Research Agency, UK; Scorer, F. J., Defence Research Agency, UK; Advanced Aero-Engine Concepts and Controls; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Active control technology (ACT), as applied to modern conventional take-off and landing (CTOL) aircraft has been extended to integrate the flight and propulsion control systems of a Harrier aircraft. This extension allows the direct control of all the forces generated on the aircraft, but it is the control concepts and management options, that are under investigation. An experimental integrated flight and propulsion system (IFPC) has completed Phase 1 flight trials and has demonstrated consistent pilot workload reduction for the recovery task. Comparisons between different methods of controlling the aircraft, including a 1-inceptor option, are presented and the implications for the technology on the engine power off-take for hover control is discussed.
Author
Active Control; Control Theory; Harrier Aircraft; V/STOL Aircraft; Workloads (Psychophysiology); Propulsion System Performance; Aircraft Control; Control Systems Design

19960054451 Pratt and Whitney Aircraft, West Palm Beach, FL USA
Integrated Flight and Propulsion Control Simulation Tools for Advanced Aircraft and Propulsion Systems
Sobanski, Kurt J., Pratt and Whitney Aircraft, USA; Khalid, Irfan, Pratt and Whitney Aircraft, USA; Advanced Aero-Engine Concepts and Controls; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper discusses the accomplishments and benefits of the PROLIFIC, a tool set for the development and evaluation of an integrated flight and propulsion control (IFPC) system for flight critical applications. The material presented focuses on IFPC development tools for present and future military tactical aircraft. These tools are required to develop and thoroughly verify all propulsion system components prior to flight. Propulsion control systems become flight critical for aircraft configurations such as short take-off and vertical landing (STOVL) and reduced tail area aircraft with thrust vectoring engine nozzles. As aircraft flight control systems become more coupled with propulsion systems, so does the need for highly integrated control laws and associated development tools such as PROLIFIC.
Derived from text
Aircraft Engines; Flight Control; Propulsion System Configurations; Thrust Vector Control; V/STOL Aircraft; Control Systems Design; Software Development Tools

19960054452 NASA Lewis Research Center, Cleveland, OH USA
Integrated Flight and Propulsion Controls for Advanced Aircraft Configurations
Merrill, Walter, NASA Lewis Research Center, USA; Garg, Sanjay, NASA Lewis Research Center, USA; Jun. 1996; 10p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The research vision of the NASA Lewis Research Center in the area of integrated flight and propulsion controls technologies is described. In particular, the integrated method for propulsion and airframe controls developed at the Lewis Research Center is described including its application to an advanced aircraft configuration. Additionally, future research directions in integrated controls are described.
Author
Aircraft Configurations; Propulsion System Configurations;

Systems Integration; Research Facilities; Control Systems Design; Aircraft Engines; Computerized Simulation

19960054453 Wright Lab., Wright-Patterson AFB, OH USA
Propulsion Integration Issues for Advanced Fighter Aircraft
Gridley, Marvin C., Wright Lab., USA; Walker, Steven H., Wright Lab., USA; Jun. 1996; 12p; In English; Also announced as 19960054418; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper describes a baseline inlet system with respect to propulsion integration technologies. Previous operational inlet designs maximized total pressure recovery, minimized distortion at the engine face, and minimized overall frontal observables. Current budgetary realities have caused a shift in the technology development approach to maintaining current levels of inlet system aerodynamic performance at a reduced life cycle cost and/or increased aircraft utility. The current USAF inlet technology development goals for the year 2000 include: a decreased inlet weight by 50% from current baselines, a decreased inlet volume by 50% from current baselines, and maintain or increase current inlet performance levels. The baseline inlet system is the current state-of-the-art in inlet systems technology, a caret inlet aperture with a long, serpentine subsonic diffuser. This design provides for high aerodynamic performance and survivability throughout the tactical fighter envelope.
Derived from text
Aerodynamic Characteristics; Engine Inlets; Inlet Airframe Configurations; Inlet Nozzles; Aircraft Design; Life Cycle Costs; Nozzle Geometry; Technology Utilization

08
AIRCRAFT STABILITY AND CONTROL

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

19960053848 Air Force Inst. of Tech., National Air Intelligence Center, Wright-Patterson AFB, OH USA
Engineering Design of Guidance Laws for Minimum-Altitude Interception
Lin, Weisong, Air Force Inst. of Tech., USA; Mar. 14, 1996; 18p; In English
Contract(s)/Grant(s): F33657-88-D-2188
Report No.(s): AD-A306684; NAIC-ID(RS)T-0639-95; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper briefly discusses two guidance laws used for minimum altitude (or sea-top) target interception in remote guidance: K-prepositioned point method and e-prepositioned point method. Also, it explains some major factors to be considered in their design, and the design methods and procedures are given which are based on them.
DTIC
Missile Control; Interception; Guidance (Motion)

19960054271 California Polytechnic State Univ., San Luis Obispo, CA USA
Designing Low Bandwidth Propulsive-Only Flight Controllers
Biezad, Daniel J., California Polytechnic State Univ., USA; Azzano, Christopher P., Department of the Air Force, USA; 1996; 9p; In English
Contract(s)/Grant(s): NCC2-711
Report No.(s): NASA-CR-202407; NAS 1.26:202407; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Results from an investigation of using engine commands to control flight attitude are described. In-flight operation with simulated failed flight controls is reviewed and ground simulations of piloted propulsive-only control to touchdown are analyzed. A design of an optimal control law to assist the pilot is presented. Recommendations are made for more robust design and implementation. Results to date indicate that simply and effective augmented control can be achieved in a wide variety of failed configurations.
Author (AIAA)
Attitude (Inclination); Flight Control; Control Simulation; Engine Control; Dynamical Systems; Propulsion System Configurations; Optimal Control

19960054339 California Polytechnic State Univ., Aeronautical Engineering Dept., San Luis Obispo, CA USA
Low Bandwidth Robust Controllers for Flight ***Final Report, Jun. 1991 - Dec. 1992***
Biezad, Daniel J., California Polytechnic State Univ., USA; Chou, Hwei-Lan, California Polytechnic State Univ., USA; May 1993; 66p; In English
Contract(s)/Grant(s): NCC2-811
Report No.(s): NASA-CR-202406; NAS 1.26:202406; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Through throttle manipulations, engine thrust can be used for emergency flight control for multi-engine aircraft. Previous study by NASA Dryden has shown the use of throttles for emergency flight control to be very difficult. In general, manual fly-by-throttle is extremely difficult - with landing almost impossible, but control augmentation makes runway landings feasible. Flight path control using throttles-only to achieve safe emergency landing for a large jet transport airplane, Boeing 720, was investigated using Quantitative Feedback Theory (QFT). Results were compared to an augmented control developed in a previous simulation study. The control augmentation corrected the unsatisfactory open-loop characteristics by increasing system bandwidth and damping, but increasing the control bandwidth

substantially proved very difficult. The augmented pitch control is robust under no or moderate turbulence. The augmented roll control is sensitive to configuration changes.
Author
Flight Control; Jet Aircraft; Bandwidth; Controllers; Thrust

19960054478 California Polytechnic State Univ., San Luis Obispo, CA USA
The Propulsive-Only Flight Control Problem ***Final Report***
Blezad, Daniel J., California Polytechnic State Univ., USA; 1996; 7p; In English
Contract(s)/Grant(s): NCC2-711
Report No.(s): NASA-CR-202408; NAS 1.26:202408; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Attitude control of aircraft using only the throttles is investigated. The long time constants of both the engines and of the aircraft dynamics, together with the coupling between longitudinal and lateral aircraft modes make piloted flight with failed control surfaces hazardous, especially when attempting to land. This research documents the results of in-flight operation using simulated failed flight controls and ground simulations of piloted propulsive-only control to touchdown. Augmentation control laws to assist the pilot are described using both optimal control and classical feedback methods. Piloted simulation using augmentation shows that simple and effective augmented control can be achieved in a wide variety of failed configurations.
Author
Aircraft Control; Attitude Control; Flight Control; Control Theory; Propulsion; Propulsion System Performance; Thrust Control

19960054479 California Polytechnic State Univ., San Luis Obispo, CA USA
Pilot-in-the-Loop Analysis of Propulsive-Only Flight Control Systems ***Final Report***
Chou, Hwei-Lan, California Polytechnic State Univ., USA; Biezad, Daniel J., California Polytechnic State Univ., USA; 1996; 7p; In English
Contract(s)/Grant(s): NCC2-711
Report No.(s): NASA-CR-202409; NAS 1.26:202409; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Longitudinal control system architectures are presented which directly couple flight stick motions to throttle commands for a multi-engine aircraft. This coupling enables positive attitude control with complete failure of the flight control system. The architectures chosen vary from simple feedback gains to classical lead-lag compensators with and without prefilters. Each architecture is reviewed for its appropriateness for piloted flight. The control systems are then analyzed with pilot-in-the-loop metrics related to bandwidth required for landing. Results indicate that current and proposed bandwidth requirements should be modified for throttles only flight control. Pilot ratings consistently showed better ratings than predicted by analysis. Recommendations are made for more robust design and implementation. The use of Quantitative Feedback Theory for compensator design is discussed. Although simple and effective augmented control can be achieved in a wide variety of failed configurations, a few configuration characteristics are dominant for pilot-in-the-loop control. These characteristics will be tested in a simulator study involving failed flight controls for a multi-engine aircraft.
Author
Control Systems Design; Pilot Performance; Flight Control; Feedback Control; Thrust Control; Manual Control; Attitude Control

19960054480 California Polytechnic State Univ., San Luis Obispo, CA USA
Application of QFT to the Problem of Failed In-Flight Controllers During Approach and Landing of a B720 Aircraft ***Final Report***
Chou, Hwei-Lan, California Polytechnic State Univ., USA; Biezad, Daniel J., California Polytechnic State Univ., USA; 1996; 7p; In English
Contract(s)/Grant(s): NCC2-711
Report No.(s): NASA-CR-202410; NAS 1.26:202410; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Previous studies by NASA Dryden have shown the use of throttles for emergency flight control to be extremely difficult, especially for landing. Flight control using only the throttles to achieve safe landing for a large jet transport airplane, the Boeing 720, is investigated using Quantitative Feedback Theory (QFT). Results are compared to an augmented control developed in a previous study. The controller corrected unsatisfactory open-loop characteristics by increasing system bandwidth and damping, but improving the control bandwidth substantially proved very difficult. The pitch controller is robust in conditions of no or moderate turbulence. The roll controller performed well in conditions of no turbulence, but is sensitive to moderate turbulence. Handling qualities of the augmented control for approach and landing were evaluated by piloted simulation flights.
Author
Controllers; Failure; In-Flight Monitoring; Landing; Boeing 720 Aircraft

19960055127 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Flight and Ground Testing of New Flight Control for the F/A-18 Hornet
Loria, C. J., Naval Air Warfare Center, USA; Beck, Evin, Naval Air Warfare Center, USA; Apr. 17, 1996; 24p; In English
Report No.(s): AD-A307768; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Our briefing will cover the following: (1) F/A-18 aircraft; (2) An overview of the Hornet's flight control systems; (3) A brief synopsis of selected flight control system related mishaps; (4) Our testing of the software, or 'Operational Flight Program' which in a highly augmented, fly-by-wire aircraft constitutes a new flight control system; and (5) Results and conclusions. A brief overview of lessons learned is also included.
DTIC
Computer Programs; F-18 Aircraft; Flight Control; Ground Tests; Flight Tests; Systems Analysis

09
RESEARCH AND SUPPORT FACILITIES (AIR)

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

19960051439 National Aerospace Lab., Kakuda, Japan
Figure control simulations of streamline adaptive-walls
Nakamura, Masayoshi, National Aerospace Lab., Japan; Hanzawa, Asao, National Aerospace Lab., Japan; 1996; ISSN 0389-4010; 20p; In Japanese
Report No.(s): NAL-TR-1284; UDC 681.513.675; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Because aerodynamic interferences between an airfoil model and wind-tunnel walls cannot be avoided in the structure of wind tunnels, the concept of the adaptive-wall was introduced to reduce the previous interferences. This paper presents numerical simulations of of streamlined adaptive-wall control for a two-dimensional wind tunnel. Numerical inner and outer flows of the wind tunnel are calculated simultaneously and independently on the basis of Euler equations using a finite difference method in the Cartesian grid. The concept of the adaptive-wall requires that the inner flow match the outer flow at control surfaces. this requirement is satisfied by matching the pressure at two independent wall surfaces. Numerical wind tunnel tests of NACA0012 and CAST10 airfoils were performed to demonstrate the potential applications of the adaptive-wall control. Several calculated results of airfoil abilities in the numerical wind tunnel are compared with experimental and other calculated results.
Author
Wind Tunnel Walls; Aerodynamic Interference; Airfoils; Adaptive Control; Finite Difference Theory; Simulation

19960052571 Naval Postgraduate School, Monterey, CA USA
Design and Analysis of a Gas Turbine Test Facility Air System
Phelps, David D., Naval Postgraduate School, USA; Dec. 1995; 68p; In English; Original contains color plates
Report No.(s): AD-A306013; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A gas turbine test facility air system has been designed to meet specified design objectives. An analytical evaluation was performed on the air system design to verify that these design objectives were achieved. A key element of the air system is an exhaust eductor which was included in the design to provide secondary cooling air flow through the engine test cell. Two analytical models were developed to evaluate exhaust eductor performance. A one-dimensional, incompressible eductor model was developed that predicts the basic eductor performance parameters including the amount of secondary air flow drawn through the engine test cell for varying eductor configurations. This model also predicts overall air system performance parameters. An eductor computational fluid dynamics analytical model was developed that provides a more detailed analysis of the flow in the eductor.
DTIC
Gas Turbines; Test Facilities; Secondary Flow; Engine Tests; Air Flow

19960052710 NASA Washington, Washington, DC USA
Ground Support Equipment
May 10, 1996; 42p; In English
Report No.(s): NASA-TM-110478; NASA-STD-5005; NAS 1.15:110478; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This standard establishes the general characteristics, performance, design, test, safety, reliability, maintainability, supportability, and quality requirements for ground support systems and equipment intended for use at NASA launch, landing, or retrieval locations. This standard specifies the criteria to provide simple, robust, safe, reliable, maintainable, supportable, and cost-effective ground support equipment (CRSE) necessary to support space vehicle and payload launch operations. This standard also recommends preferred engineering practices for NASA programs and projects. Determining the suitability of this standard and its provisions is the responsibility of program/project management and the performing organization. Existing programs and contracts may continue to use existing program or contract-unique GSE design requirements for the life of the program or contract (including follow-on contracts) on existing or new GSE for that program or contract. Retrofit of existing GSE to comply with this standard is at the discretion of the applicable program or project office. When this standard is used in a procurement action, the standard should be reviewed by the program/project office for applicability, and only the sections that apply to the project or program should be included in the procurement documentation. The revision of this standard that was current at the time directions are issued to design, construct, manufacture, or procure the GSE shall be applicable for the useful life of the GSE. Modifications of existing GSE may be done so the modified GSE complies with the revision that is current at the time directions are issued to

modify the GSE. This standard does not apply to facilities. The criteria of this standard may be used for the GSE used at the manufacturing, development, or test sites prior to arrival at the launch, landing, or retrieval sites. This standard is recommended for the design of nonflight hardware and software used to support the operations of transporting, receiving, handling, assembly, test, checkout, service, and launch of space vehicles and payloads at the launch, landing, or retrieval sites.
Author
Standards; Ground Support Equipment; Ground Support Systems

19960052849 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
The Automated Wingman: An Airborne Companion for Users of DIS Compatible Flight Simulators
Edwards, Mark M., Air Force Inst. of Tech., USA; Dec. 1995; 117p; In English
Report No.(s): AD-A305754; AFIT/GCE/ENG/95D-01; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A major problem encountered by users of distributed virtual environments is the lack of simulators available to populate these environments. This problem is usually remedied by using computer generated entities. Unfortunately, these entities often lack adequate human behavior and are readily identified as non-human. This violates the realism premise of distributed virtual reality and is a major problem, especially in training situations. This thesis addresses the problem by presenting a computer generated entity called the Automated Wingman. The Automated Wingman is a semi-automated computer generated aircraft simulator that operates under the control of a designated lead simulator and integrates distributed virtual environments with intelligence. Access to distributed virtual environments is provided through the DIS protocol suite while human behavior is obtained through the use of a fuzzy expert system and a voice interface. The fuzzy expert system is designed around a hierarchy of knowledge bases. Each of these knowledge bases contains a set of fuzzy logic based linguistic variables that control the actions of the Automated Wingman. The voice interface allows the pilot of the lead simulator to direct the activity of the Automated Wingman. This thesis describes the design of the Automated Wingman and presents the current status of its implementation.
DTIC
Virtual Reality; Computerized Simulation; Flight Simulators; Flight Simulation; Distributed Processing; Expert Systems; Internets

19960052907 National High Magnetic Field Lab., Tallahassee, FL USA
Design of a Superconducting Magnetic Suspension System for a Liquid Helium Flow Experiment
Smith, Michael R., National High Magnetic Field Lab., USA; Eyssa, Yehia M., National High Magnetic Field Lab., USA; VanSciver, Steven W., National High Magnetic Field Lab., USA; Third International Symposium on Magnetic Suspension Technology; Jul. 1996; vol. Part 1, pp. 37-48; In English; Also announced as 19960052904
Contract(s)/Grant(s): N66604-96-C-A093; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

We discuss a preliminary design for a superconducting magnetic suspension system for measurement of drag on rotationally symmetric bodies in liquid helium. Superconducting materials are a natural choice for liquid helium studies, since temperatures are well below most critical temperatures, so that the resulting heat load is negligible. Also, due to its diamagnetic properties, a superconducting model (for example made or coated with Nb) is inherently stable against disturbances. Issues which we consider include model placement during initial cool-down, maintaining placement during anticipated drag and lift forces, and force measurement. This later can be achieved by a passive technique, where the body is allowed to deflect under the influence of drag from its neutral position. The resulting shift in flux is detected via a superconducting pickup coil. The pickup coil may be connected either to a SQUID, or a secondary loop wound around a Hall probe. Both options are discussed. The objective of this work is to gain a better understanding of the nature of turbulent fields in normal and superfluid helium for potential application to problems in classical high Reynolds number turbulence.
Author
Magnetic Suspension; Liquid Helium; Liquid Flow; Drag Measurement; Squid (Detectors); Magnetic Measurement

19960054115 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX USA
MEMS Spaceborne Testbed
Holderman, Mark, National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, USA; Stroud, Robert H., Aerospace Corp., USA; 1995; 1p; In English; Also announced as 19960054083; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche; Abstract Only; Abstract Only

Micro-electro-mechanical-systems (MEMS) technology can significantly reduce the cost to design, launch and operate space systems. MEMS technology offers low cost, small light weight and reliable devices which can significantly reduce the size, weight and cost of spacecraft while increasing their reliability through durability and redundancy. A standard spaceborne interface/cabinet that is readily available for experiments for inexpensive testing of MEMS devices in space is discussed. The MEMS testbed will provide fixtures for holding MEMS devices, ambient environment monitoring, an assortment of available operating voltages, RF and low frequency signal inputs, sources of various gases and pressure monitors, a command and control interface computer, and a

data interface which will record or transmit the data and performance parameters of these small systems.
Derived from text
Command and Control; Environmental Monitoring; Spaceborne Experiments; Reliability; Microminiaturization; Microminiaturized Electronic Devices; Test Stands

19960055179 NASA Langley Research Center, Hampton, VA USA
Finite Element Analysis of a NASA National Transonic Facility Wind Tunnel Balance
Lindell, Michael C., NASA Langley Research Center, USA; 1996; 14p; In English; International Symposium on Strain-Gage Balances, 22-25 Oct. 1996, Langley, VA, USA
Report No.(s): NASA-TM-110481; NAS 1.15:110481; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents the results of finite element analyses and correlation studies performed on a NASA National Transonic Facility (NTF) Wind Tunnel balance. In the past NASA has relied primarily on classical hand analyses, coupled with relatively large safety factors, for predicting maximum stresses in wind tunnel balances. Now, with the significant advancements in computer technology and sophistication of general purpose analysis codes, it is more reasonable to pursue finite element analyses of these balances. The correlation studies of the present analyses show very good agreement between the analyses and data measured with strain gages and therefore the studies give higher confidence for using finite element analyses to analyze and optimize balance designs in the future.
Author
Finite Element Method; Weight Indicators; Strain Gage Balances; Stress Analysis; Wind Tunnel Apparatus; Transonic Wind Tunnels

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ASTRONAUTICS

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

19960052666 Ceskoslovenska Akademie Ved, Prague, Czechoslovakia
Publications of the Astronomical Institute of the Academy of Sciences of the Czech Republic, No. 82, Project CESAR: Papers Relevant to Microaccelerometric Experiment MACEK
Publications of the Astronomical Institute of the Academy of Sciences of the Czech Republic; 1994; 43p; In English; Also announced as 19960052667 through 19960052670; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

CESAR is a light scientific satellite developed in cooperation between Italy, Hungary, Poland, Slovakia, and the Czech Republic within the frame of the Central European Initiative. The acronym of CESAR means the 'Central European Satellite for Advanced Research' and its content characterizes a mission which will study the magnetosphere-ionosphere-thermosphere Earth environment by contemporary set of instruments. Czech Republic supplies the satellite with a solar X-ray photometer and, especially, by an triaxial accelerometer of high sensitivity - the utilization of this instrument ia a basis for the papers presented here. The proper functioning of this accelerometer depends not only on a top-quality realization of its mechanical as well as electronical parts, but on a proper choice of the satellite orbit as well. The aim of the microaccelerometric measurements is to provide the data for the thermosphere total density distribution and variation modelling as well as the radiation effects assessment. Therefore, we are studying the CESAR project from the point of view of the suggested orbital properties to ensure a proper data reduction and interpretation.
Author
Scientific Satellites; Density Distribution; Accelerometers; Radiation Effects; Thermosphere; Radiation Pressure; Aerodynamic Drag; Atmospheric Density

19960052670 Czech Technical Univ., Prague, Czechoslovakia
Atmospheric Drag Acceleration, Illumination and Sun-Synchronous Orbit of the CESAR Satellite
Kabelac, J., Czech Technical Univ., Czechoslovakia; Publications of the Astronomical Institute of the Academy of Sciences of the Czech Republic; 1994, no. No. 82, pp. 40-42; In English; Also announced as 19960052666; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Some characteristics and remarks about the satellite of CEI (Central European Initiative), called CESAR (Central European Satellite for Advanced Research) are presented. First of all, they concern the measurement of the acceleration caused by the non-gravitational forces acting on the motion of the near-Earth satellite. The measurement will be done by a very sensitive microaccelerometer. We calculated and constructed the graphs of the acceleration curves for input orbital elements and for the TD88 (Total Density 1988) atmospheric model. We used a non-rotating and a rotating atmosphere. We paid attention to determination of the time interval of the CESAR satellite illumination during the year 1997, the expected launching time. The calculation of sun-synchronous orbital elements completes is provided.
Author
Artificial Satellites; Aerodynamic Drag; Satellite Orbits; Acceleration (Physics); Orbital Elements

19960054006 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Mars Pathfinder Status at Launch

Spear, A. J., Jet Propulsion Lab., California Inst. of Tech., USA; Freeman, Delma C., Jr., NASA Langley Research Center, USA; Braun, Robert D., NASA Langley Research Center, USA; International Astronautical Congress; 1996; 12p; In English; 47th; International Astronautical Congress, 7-11 Oct. 1996, Beijing, China

Report No.(s): IAF-96-Q.3.02; NASA-TM-110472; NAS 1.15:110472; Copyright Waived (NASA); Avail: CASI; A03, Hardcopy; A01, Microfiche

The Mars Pathfinder Flight System is in final test, assembly and launch preparations at the Kennedy Space Center in Florida. Launch is scheduled for 2 Dec. 1996. The Flight System development, in particular the Entry, Descent, and Landing (EDL) system, was a major team effort involving JPL, other NASA centers and industry. This paper provides a summary Mars Pathfinder description and status at launch. In addition, a section by NASA's Langley Research Center, a key EDL contributor, is provided on their support to Mars Pathfinder. This section is included as an example of the work performed by Pathfinder team members outside JPL.

Author

Mars Pathfinder; Mars Landing; Parachute Descent; Spacecraft Instruments; Aerothermodynamics; Computerized Simulation

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CHEMISTRY AND MATERIALS

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

19960052223 Sandia National Labs., FAA Airworthiness Assurance NDI Validation Center, Albuquerque, NM USA

Validation of bonded composite doubler technology through application oriented structural testing

Roach, Dennis, Sandia National Labs., USA; Graf, Darin, Sandia National Labs., USA; 1996; 15p; In English; 11th; Fibrous Composites in Structural Design, 26-29 Aug. 1996, Fort Worth, TX, USA; Sponsored by NASA Washington, USA

Contract(s)/Grant(s): DE-AC04-94AL-85000

Report No.(s): SAND-96-1860C; CONF-960847-1; DE96-013246; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

One of the major thrusts established under the FAA's National Aging Aircraft Research Program is to foster new technologies associated with civil aircraft maintenance. Recent DOD and other government developments in the use of bonded composite patches on metal structures has supported the need for research and validation of such doubler applications on U.S. certificated airplanes. Composite patching is a rapidly maturing technology which shows promise of cost savings on aging aircraft. Sandia Labs is conducting a proof-of-concept project with Delta Air Lines, Lockheed Martin, Textron, and the FAA which seeks to remove any remaining obstacles to the approved use of composite doublers. By focusing on a specific commercial aircraft application - reinforcement of the L-1011 door frame - and encompassing all 'cradle-to-grave' tasks such as design, analysis, installation, and inspection, this program is designed to prove the capabilities of composite doublers. This paper reports on a series of structural tests which have been conducted on coupons and subsize test articles. Tension-tension fatigue and residual strength tests attempted to grow engineered flaws in coupons with composite doublers bonded to aluminum skin. Also, structures which modeled key aspects of the door corner installation were subjected to extreme tension, shear, and bending loads. In this manner it was possible to study strain fields in and around the Lockheed-designed composite doubler using realistic aircraft load scenarios and to assess the potential for interply delaminations and disbonds between the aluminum and the laminate. The data acquired was also used to validate finite element models (FEM) and associated Damage Tolerance Analyses.

DOE

Commercial Aircraft; Aircraft Maintenance; Composite Structures; Composite Materials; Bonding; Fatigue Tests; Tensile Tests; Strain Distribution; Residual Strength; Aircraft Structures

19960052715 Office National d'Etudes et de Recherches Aerospatiales, Paris, France

Experimental and Numerical Study of a Burning Spray Achieved by a Liquid-Gas Coaxial Injector *Etude experimentale et numerique du brouillard en combustion issu d'un injecteur coaxial liquide-gaz, no. 8*

Zamuner, Bernard, Office National d'Etudes et de Recherches Aerospatiales, France; 1996; 358p; In French; Original contains color illustrations; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

This work is a contribution to spray combustion study in propulsive chambers of air and space transportation systems. After a first chapter where a review of available experimental and numerical techniques is done, the selected experimental setup is presented in the second part. Inspired by storable liquid-fueled rocket engines, it consists of a coaxial injector, with an inner liquid jet of monomethylhydrazine (M.M.H.) surrounded by an oxygen-rich gas jet. A detailed investigation of the isothermal spray at the atmospheric pressure is performed with a phase-Doppler particle analyzer. The third part is devoted to the development and the validation of a numerical code intended to the simulation of the isothermal flow. The Eulerian approach is used for both phases. The gas phase tur-

bulence is described by a k-Epsilon model whereas the droplet turbulent dispersion is taken into account through a zero-equation viscosity concept. In the last chapter, attention is given to the burning spray. First, analyses of the light scattered by liquid droplets crossing a laser planar sheet reveal the existence of two combustion modes depending on the exit velocities ratio. A droplet sizing technique based on image processing of movie pictures is proposed. A spray combustion model is then used to predict the reactive flow. Comparisons of droplet diameter and concentration evolution with experimental data are encouraging. Finally, numerical computations allow us to give an explanation to the two combustion regimes.
Author
Combustion Physics; K-Epsilon Turbulence Model; Gas Jets; Liquid Propellant Rocket Engines; Methylhydrazine; Space Transportation System; Vapor Phases; Atmospheric Pressure; Air Transportation; Isothermal Flow

19960052822 Argonne National Lab., IL USA
Development of lubricious coatings for advanced turbine engine applications
Erdemir, A., Argonne National Lab., USA; Fenske, G. R., Argonne National Lab., USA; Munson, J. H., Allison Engine Co., USA; Feb. 1996; 17p; In English; 29th; Isata: International Symposium on Automotive Technology and Automation: Dedicated Conference on Electric, Hybrid and Alternative Fuel Vehicles, 2 - 6 Jun. 1996, Florence, Italy
Contract(s)/Grant(s): W-31109-eng-38
Report No.(s): ANL/ET/CP-88594; CONF-960629-2; DE96-012806; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Development of durable and low-cost high-temperature lubricants for use in gas-turbine regenerator cores is critically important for achieving improved performance and fuel-efficiency in future automotive and hybrid-electric vehicles. Successful development and implementation of such coatings could have substantial technological and economic impacts on energy conservation and could reduce dependence on imported oil. Furthermore, this technology may also contribute to a cleaner environment by reducing emissions. Argonne National Laboratory is exploring new oxide-based lubricious coatings that can meet the stringent tribological conditions of advanced regenerator cores and seals. One of the key elements of this project involves the development of new ceramic and alloy coatings that will reduce friction and wear at temperatures up to 2,000 F. This paper will highlight the recent research in high-temperature lubrication and in the development of new and improved carbon-carbon and carbon-polyimide based composites that can be used at temperatures up to 1,100 F.
DOE
Turbine Engines; Lubrication; Regenerators; Durability; Low Cost; Metal Coatings; High Temperature Lubricants

19960053116 Alcoa Technical Center, ,Alcoa Center,PA
The Role of Microstructure on the Fatigue Durability of Aluminum Aircraft Alloys ***Final Report, 16 Sep. 1991- 15 Dec. 1995***
Magnusen, Paul E., Alcoa Technical Center; Bucci, Robert J., Alcoa Technical Center; Hinkle, Andrew J., Alcoa Technical Center; Brockenbrough, John R., Alcoa Technical Center; Konish, Harold J., Alcoa Technical Center; Miyasato, Shelly M., Alcoa Technical Center; Apr. 15, 1996; 180p; In English
Contract(s)/Grant(s): N00014-91-C-0128; ISBN-3-1176-01421-7484; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Although the role of microstructure on the initiation and growth of fatigue cracks, and thus the fatigue performance of a structural metal has long been recognized, quantitative models of the linkage(s) between microstructural characteristics and structural fatigue performance have not been widely available. The absence of such models, coupled with the compositional basis of material specifications, has limited the ability to exploit improvements in material performance which have been generated by microstructural consequences of manufacturing process improvements. The potential performance benefits of quality-improved materials have thus remained inaccessible to airframers, who lack the means of specifying such materials or characterizing their merits without committing massive testing resources. Opportunities for reducing airframe weight and/or cost have thus been lost. A program of experimental and analytical tasks has been conducted to develop a path for defining the linkage(s) between microstructural characteristics and fatigue performance in an aluminum alloy typically used for airframe structural applications. Within the framework of this overall objective, life-limiting microstructural features have been classified and ranked by severity, and models to quantitatively describe the evolution and growth of macrostructural cracks from those features have been developed. The use of these models to probabilistically describe the structural implications of different levels of microstructural quality has been demonstrated, thereby allowing the effects of material pedigree to be predictively linked with the structural integrity of end components. The focus of this work was on several process variants of aluminum alloy 7050-T7451 thick plate. This was dictated by customer interest. The widespread use of thick plate for flight-critical airframe structural components, and the particular characteristics associated with the manufacturing, service, and maintenance of thick section components. Despite this very specific basis, the results of this contracted activity are expected to be generally applicable to other structural metals as well. The conceptual framework developed within this program is also broadly applicable to evaluating structural implications of extrinsic damage forms introduced during manufacturing or service (e.g., corrosion pits, scratches, tool marks) in addition to intrinsic microstructural features. Implications of the program results are broad and far-reach-

ing. The modeling framework has potential applications in the airframe design process, and is a potentially significant enabler for the material and product form selection processes. It also provides an avenue for predictively assessing the implications of manufacturing and maintenance operations on airframe structural integrity, and thus, on service life. A number of validation and demonstration tasks must be conducted, however, before the full potential of the basic technology can be realized.
Author
Aluminum Alloys; Microstructure; Crack Propagation; Fatigue Life; Aircraft Construction Materials; Fatigue (Materials); Airframes

19960054079 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
High-Performance, Low Volatile Organic Compound Content Epoxy Systems for Naval Aircraft Coatings, ***Oct. 1993-Jun. 1995***
Kovaleski, Kevin J., Naval Air Warfare Center, USA; Granata, Richard D., Lehigh Univ., USA; Spadafora, Stephen J., Naval Air Warfare Center, USA; Dec. 28, 1995; 22p; In English
Report No.(s): AD-A306634; NAWCADPAX--96-41-TR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

New environmental regulations have prompted the need for organic coatings with low Volatile Organic Compound (VOC) levels that maintain the properties of their high VOC counterparts. Loss of solvents creates such problems as poor film formation and high application viscosity. The effects of low molecular weight polymers and reactive diluents in coating formulations were studied with respect to properties deemed essential for overall operational readiness of naval aircraft. Such materials were incorporated into a compliant, high-gloss epoxy topcoat. While attempts to improve the properties of the topcoat under extreme conditions were unsuccessful, the new system met all the requirements of MIL-C-22750, the Military Specification for an epoxy topcoat. The coating also exceeded the performance of the control formulation in many categories, including a reduction of VOC's by 40%.
DTIC
Organic Compounds; Coatings; Aircraft Carriers; Epoxy Compounds

19960054474 Virginia Univ., School of Engineering and Applied Science, Charlottesville, VA USA
NASA-UVa Light Aerospace Alloy and Structures Technology Program: Aluminum-Based Materials for High Speed Aircraft ***Semiannual Report, 1 Jan. 1993 - 30 Jun. 1993***
Starke, E. A., Jr., Editor, Virginia Univ., USA; Sep. 1996; 228p; In English
Contract(s)/Grant(s): NAG1-745; RTOP 537-06-20-06
Report No.(s): NASA-CR-4754; NAS 1.26:4754; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This report is concerned with 'Aluminum-Based Materials for High Speed Aircraft' which was initiated to identify the technology needs associated with advanced, low-cost aluminum base materials for use as primary structural materials. Using a reference baseline aircraft, these materials concept will be further developed and evaluated both technically and economically to determine the most attractive combinations of designs, materials, and manufacturing techniques for major structural sections of an HSCT. Once this has been accomplished, the baseline aircraft will be resized, if applicable, and performance objectives and economic evaluations made to determine aircraft operating costs. The two primary objectives of this study are: (1) to identify the most promising aluminum-based materials with respect to major structural use on the HSCT and to further develop those materials, and (2) to assess these materials through detailed trade and evaluation studies with respect to their structural efficiency on the HSCT.
Author
Aluminum Alloys; Supersonic Transports; Composite Materials

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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.

19960051292 Royal Military Coll. of Canada, Materials Evaluation Lab., Kingston, Ontario Canada
Acoustic Emission Monitoring of Full-Scale Fatigue Tests on Canadian Forces Aerospace Structures
McBride, Stuart L., Royal Military Coll. of Canada, Canada; Deziel, Gerald, National Defence Headquarters, Canada; LeGuellec, Serge, National Defence Headquarters, Canada; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 239-254; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Acoustic emission monitoring is based on the fact that an incremental change in a defect as the result of applied stress radiates an acoustic wave through the surrounding material. This stress wave can be detected by a piezoelectric sensor to become a measure of the incremental change in the defect. The acoustic emission method has been investigated extensively in Canada for application to structures both in the laboratory and during flight. This paper summarizes the recent use of acoustic emission in the CF-116 (CF-5) full scale durability and damage tolerance tests (FSDDTT) during 15,500 equiva-

lent flying hours (EFH) of continuous monitoring of 16 separate structural areas. The implementation of acoustic emission monitoring for the CF-188 international follow-on structural test project (IFOSTP) center fuselage test is also described.
Derived from text
Acoustic Emission; Aircraft Structures; Fatigue Tests; Full Scale Tests; Sound Waves; Failure Analysis; Crack Geometry; Structural Analysis

19960051298 Utah Univ., Dept. of Mechanical Engineering., Salt Lake City, UT USA
Effect of Test Parameters on the Corrosion Fatigue Crack Growth of Aircraft Structural Materials
Hoeppner, David W., Utah Univ., USA; Goswami, Tarun, Utah Univ., USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 489-508; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper examines the effects of test parameters on the corrosion fatigue crack growth behavior in aircraft structural materials. Test parameters such a stress ratio, frequency, hold time, temperature, pH level of the media, and other parameters are known to alter the corrosion fatigue crack growth rates in aircraft structural materials. It is shown that there are numerous laboratory test variables which affect the crack growth rates, which in an operating environment of a aircraft are not characterized. Therefore, the additional compilation of such data will help establish inspection intervals and assure reliability of safety procedures by assuring the availability of appropriate data.
Author
Aircraft Structures; Stress Corrosion Cracking; Crack Propagation; Schedules; Inspection; Fatigue (Materials)

19960051299 Utah Univ., Quality and Integrity Design Engineering Center., Salt Lake City, UT USA
The Role of Fretting Corrosion and Fretting Fatigue in Aircraft Rivet Hole Cracking *Progress Report, Dec. 1994*
Hoeppner, David W., Utah Univ., USA; Elliott, Charles B., III, Utah Univ., USA; Moesser, Mark W., Utah Univ., USA; Flournoy, Thomas H., Federal Aviation Administration, USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 509-514; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This is a status report on the FAA Grant Number 93-G-068 program to better understand the role of fretting corrosion and fretting fatigue in aircraft rivet hole cracking. Activities related to basic model and material data development, plans for a sensitivity stud of several factors related to the fabrication of riveted aircraft joints, and plans for an investigation of riveted joints from service aircraft are reported.
Author
Fretting Corrosion; Riveted Joints; Failure Analysis; Wear Resistance; Coefficient of Friction; Aircraft Structures; Fatigue (Materials)

19960051302 Sandia National Labs., Albuquerque, NM USA
Eddy Current Inspection Reliability at Airline Inspection Facilities
Spencer, Floyd W., Sandia National Labs., USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 547-561; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

High frequency eddy current inspections are an integral part of routine maintenance checks and of directed checks for surface fatigue in aircraft fuselage skins. to investigate the achieved reliability in inspections performed in aircraft maintenance facilities, an experiment using simulated lap splice joints was designed at the FAA's Aging Aircraft Nondestructive Inspection (NDI) Validation Center. The goal of the experiment was to quantify the reliability of inspections as they are routinely performed in aircraft maintenance facilities. Included in the experimental design were issues of accessibility, crack orientation, and surface condition (bare or painted). The experiment was taken to nine maintenance facilities from March to August 1993. Analyses of the data from 45 inspections are presented here in the form of probability of detection curves and false call rates. Factors found to affect the probability of detection curves are discussed briefly.
Author
Aircraft Maintenance; Eddy Currents; Probability Theory; Reliability; Fuselages; Fatigue Tests; Cracking (Fracturing); Inspection

19960051303 Metal Improvement Co., Wichita, KS USA
Exfoliation Corrosion Located by Search Peening
Harrison, James R., Metal Improvement Co., USA; Thompson, E. Roger, Thompson (E. Roger), UK; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 563-586; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Search peening can be defined as the use of controlled shot peening as a tool to expose subsurface corrosion. The stretching of the surface, coupled with the compressive stress induced by the multiple impacts of the shot help to delaminate hidden layers, as is found in exfoliation corrosion. Metal Improvement Company and British Airways have developed a method to determine the extent of corrosion so that the removal of damage can be accomplished with a high degree of accuracy. This certifiable controlled process, 'search peening', allows a minimal amount of metal removal, so that engineers have the maximum acceptable material to work with, enabling them to keep tolerances within safe limits.
Author

Compression Loads; Shot Peening; Delaminating; Wing Panels; Paint Removal; Aluminum Alloys

19960051305 NASA Lewis Research Center, Cleveland, OH USA

Structural Durability of Damaged Metallic Panel Repaired with Composite Patches

Chamis, Christos C., NASA Lewis Research Center, USA; Minnetyan, Levon, Clarkson Univ., USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 609-621; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Structural durability/damage tolerance characteristics of an aluminum tension specimen possessing a short crack and repaired by applying a fiber composite surface patch is investigated via computational simulation. The composite patch is made of graphite/epoxy plies with various layups. An integrated computer code that accounts for all possible failure modes is used for the simulation of combined fiber-composite/aluminum structural degradation under loading. Damage initiation, growth, accumulation, and propagation to structural fracture are included in the simulation. Results show the structural degradation stages due to tensile loading and illustrate the use of computational simulation for the investigation of a composite patch repaired cracked metallic panel.

Author

Graphite-Epoxy Composites; Aluminum Alloys; Computerized Simulation; Crack Propagation; Failure Modes; Aircraft Structures

19960051307 Air Force Academy, Dept. of Engineering Mechanics., CO USA

Bonded Repair of Multiple Site Damage with GLARE (TM) Fiber Metal Laminate Patches

Fredell, Robert S., Air Force Academy, USA; Mueller, Richard, Technische Hogeschool, Netherlands; Borsboom, Cees, Technische Hogeschool, Netherlands; Butkus, Lawrence, Georgia Inst. of Tech., USA; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 633-646; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Bonded composite 'crack patching' has been used successfully to extend the life of numerous cracked or corroded aircraft structures. Most crack atching has been accomplished on small areas of thick structures using relatively expensive boron/epoxy composites. Extending the lives of aging transport fuselage structures, however, may involve repairs to large areas of thin fuselage skins and lap joints. Hence, affordable materials and processes are required. The hybrid materials known as GLARE (tm), which consist of bonded alternating thin aluminum alloy sheets and glass/epoxy prepegs, present a relatively low cost alternative to boron/epoxy. Furthermore. recently published analyses have predicted that GLARE (tm) 2 can outperform boron/epoxy in crack patching of thin structures subjected to the low service temperatures experienced in a fuselage skin at cruise altitudes. This paper presents the results of constant amplitude fatigue tests performed at room temperature on large flat stiffened panels and a pressurized unstiffened fuselage 'barrel'. These specimens simulate pressurized transport fuselage structures with multiple site fatigue damage. Bonded GLARE (tm) 2 patches successfully halted the growth of multiple fuselage fatigue cracks beneath the patch. Furthermore, the presence of unrepaired fatigue damage adjacent to the bonded patch does not compromise the damage tolerant nature of the repair. The results confirm GLARE (tm) 2 to be an effective, damage tolerant fuselage repair material.

Author

Fuselages; Boron-Epoxy Composites; Laminates; Glass Fiber Reinforced Plastics; Fatigue (Materials); Fatigue Tests; Aluminum Alloys; Crack Propagation; Crack Arrest

19960051311 Technische Hogeschool, Delft, Netherlands

Fatigue Crack Initiation, Growth and Residual Strength Characteristics of Riveted Fibre Metal Laminate Lap Joints

Mueller, Richard P. G., Technische Hogeschool, Netherlands; Borsboom, C., Technische Hogeschool, Netherlands; Proceedings of the 1994 USAF Structural Integrity Program Conference; Feb. 1996, pp. 689-703; In English; Also announced as 19960051286; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Longitudinal riveted aluminum lap joints are sensitive to fatigue cracking. The internal pressurization is the crack driving force. After the onset of fatigue cracking in aluminum failure occurs soon. The squeeze force is important to extend the fatigue life.Finite element calculations showed that residual stresses occur near the hole edge, which are related to the rivet squeeze force. Tangential compressive stresses occur with large squeeze forces as well as large mating sheet clamping. Also the interference will become larger. As a consequence of larger squeeze force tangential tensile stresses occur away from the hole edge. These stresses in combination with secondary bending and fretting cause a shift in crack initiation location away from the hole edge. Also crack initiation might occur in the bottom row due to bending imperfections with higher squeeze forces. Beside the residual stresses load transfer and secondary determine the fatigue behavior. Fatigue behavior of a joint is often investigated with small coupons. This is a simplification of the fuselage loading conditions. Finite element calculations revealed a small difference in load transfer for the area not disturbed by the frames for a flat uniaxially loaded riveted lap joint coupon and a lap joint in a pressurized barrel test set-up. This is also true for secondary bending. However, the calculations cannot reveal the consequences of bi-axial streses for fatigue crack initiation and

growth. For a typical lap joint a comparison study was performed on both monolithic aluminum (2.2 mm)lap joints and Glare (1.4 mm) lap joints. For aluminum lap joints, it was possible to increase the fatigue life with a factor five, whereas for Glare this factor was more than ten. At intermediate squeeze forces and higher, fatigue lives of Glare lap joints are larger then the aluminum joints. However, Glare joints initiate earlier than the aluminum joints due to the higher stress level, but the fatigue crack growth life is substantially larger due to the fibers that bridge the crack and prevent through-the-thickness crack growth. A larger rivet squeeze force contributes to this last mentioned phenomenon. This results in low crack growth rates and unstable crack growth was not seen. In Glare lap joints, multiple site damage is always present due to the slow crack growth, but it does not lead to hazardous situations. This is in strong contridiction with monolithic aluminum lap joints.
Author
Lap Joints; Crack Initiation; Fatigue (Materials); Finite Element Method; Fuselages; Holes (Mechanics); Riveted Joints; Metal Joints

19960051457 National Aerospace Lab., Kakuda, Japan
Buckling and final failure of carbon/polyimide stiffeners
Sanbongi, Shigeo, National Aerospace Lab., Japan; Hamaguchi, Yasumasa, National Aerospace Lab., Japan; 1996; ISSN 0452-2982; 14p; In Japanese
Report No.(s): NAL-TR-1286; UDC 539.411; UDC 620.168; UDC 620.173; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The buckling and final failure (crippling) characteristics of carbon/polyimide (T-80OH/PMR-15) laminated composite stiffeners, which are one of the candidates for spaceplane structural components, were investigated. The angle section and the T-section stiffeners were tested at room temperature and at 300 C. For the angle section stiffeners, the drop in the buckling strength at 300 C was less than 5% compared with the room temperature test results when the aspect ratio is greater than 4, and the drop in the final failure strength was less than 15%. The predicted buckling strengths of the specimen with the mechanical fixture were close to the test results. For the T-section stiffeners, the primary objective of this study was to evaluate the effect of the corner radius at a flange-web junction on buckling and on final failure strength. The buckling strengths predicted with the analytical model including an actual corner shape coincide with the experimental test results, and a significant increase in buckling strength due to the increase in the corner radius was shown.
Author
Polyimides; Buckling; Composite Materials; Composite Structures; Aircraft Structures; Stiffening; Reinforcement (Structures)

19960052205 NASA Lewis Research Center, Cleveland, OH USA
Scanning Mode Sensor for Detection of Flow Inhomogeneities
Adamovsky, Grigory, Inventor, NASA Lewis Research Center, USA; Jul. 08, 1996; 24p; In English
Patent Info.: NASA-Case-LEW-16041-1; US-Patent-Appl-SN-687062
Report No.(s): NAS 1.71:LEW-16041-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A scanning mode sensor and method is provided for detection of flow inhomogeneities such as shock. The field of use of this invention is ground test control and engine control during supersonic flight. Prior art measuring techniques include interferometry, Schlieren, and shadowgraph techniques. These techniques, however, have problems with light dissipation. The present method and sensor utilizes a pencil beam of energy which is passed through a transparent aperture in a flow inlet in a time-sequential manner so as to alter the energy beam. The altered beam or its effects are processed and can be studied to reveal information about flow through the inlet which can in turn be used for engine control.
NASA
Scanners; Inhomogeneity; Engine Control; Supersonic Flight; Shock Waves; Flow Visualization

19960052241 Naval Postgraduate School, Monterey, CA USA
Particulate Sizing in Gas Turbine Exhaust Using a Laser Extinction Technique
Turner, Philip H., Naval Postgraduate School, USA; Dec. 1995; 76p; In English
Report No.(s): AD-A305921; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The measurement of soot particulates densities in gas turbine engine and rocket exhausts is an area of continuing scientific investigation. Knowledge of exhaust plume soot concentration and sizing is critical for plume signature determination, currently a focus of theatre ballistic missile defense research. This thesis research investigates the development and initial calibration of an instrument that will determine soot particle densities in an exhaust plume, by measuring the absorbtion of a light beam transmitted through the plume. This instrument utilizes an argon ion laser, four passes through the exhaust plume, and a phase conjugate crystal to correct for aberrations in the transmitted beam. Several aspects of instrument layout and performance were investigated, and an i nitial calibration against a conventional probe sampling technique was performed, using an ethelyne air combustor as a soot source. While soot concentration measurements obtained with the instrument were internally consistent, the primitive sample probe used limited the opportunity to do an accurate comparison against a conven-

tional method. The method requires further development, but shows significant promise for use in a jet engine test cell.
DTIC
Exhaust Gases; Plumes; Concentration (Composition); Engine Tests; Gas Turbine Engines; Gas Turbines; Jet Engines; Particulates; Signatures

19960052252 Naval Postgraduate School, Monterey, CA USA
Theoretical and Experimental Investigation of the Response of a Rotor Accelerating Through Critical Speed
Reed, Gregory L., Naval Postgraduate School, USA; Dec. 1995; 70p; In English
Report No.(s): AD-A305922; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The rotordynamic response of an imbalanced rotor accelerating through its first lateral bending critical speed was investigated both analytically and experimentally. A two degree-of-freedom lumped mass, damping and stiffness model was developed to simulate the response of a simply supported, single disk rotor during both acceleration and deceleration. The equations of motion were then solved numerically. The computer model was used to determine the effect of acceleration rate, asymmetric stiffness and damping, and acceleration scheduling on the maximum amplitude of the response. Experimental data for a simply supported, single disk rotor accelerating at different rates were compared with the computer model. Increased acceleration rates and damping reduce the magnitude of the response. Asymmetric stiffness and acceleration scheduling can also be used advantageously to reduce the maximum amplitude of the response.
DTIC
Computerized Simulation; Rotor Dynamics; Equations of Motion; Degrees of Freedom; Rotors

19960052256 Wright Lab., Aero Propulsion and Power Directorate, Wright-Patterson AFB, OH USA
Laser Shock Peened Compressive Residual Profile after Exposure to Temperature ***Final Report, 1 Jan. - 1 Jun. 1994***
Lykins, Chris, Wright Lab., USA; Prevey, Paul, Wright Lab., USA; Mason, Perry, Wright Lab., USA; Sep. 1995; 21p; In English
Contract(s)/Grant(s): AF Proj. 3066
Report No.(s): AD-A305914; WL-TR-95-2108; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The surface of any component that undergoes mechanical loading is particularly important in influencing the fatigue life of that part. The factors that contribute to surface fatigue sensitivity are less slip restriction at the surface, the existence of single edge cracks, the surface sees large tensile gradients when the part is exposed to bending and torsion, the surface tends to be an area of multiple defects and the surface is the most sensitive region to environmental effects such as corrosion. Compressive residual stresses are utilized in the turbine engine environment to counteract regions on the surface that must withstand high tensile stresses.
DTIC
Turbine Engines; Tensile Stress; Residual Stress; Fatigue Life; Environment Effects; Defects; Cracks; Bending Aluminum Alloys; Projectiles; Reinforcing Materials; Steels; Teflon (Trademark); Aircraft Engines; Engine Failure; Impact Damage

19960052293 Yamaguchi Univ., Faculty of Engineering, Ube, Japan
Fluid Forces Acting on a Circular Cylinder Immersed in a Sinusoidally Oscillating Flow at a Low Keulegan-Carpenter Number
Saitou, Takasi, Yamaguchi Univ., Japan; Hirata, Yukiyasu, Yamaguchi Univ., Japan; Urakawa, Kazuhisa, Yamaguchi Univ., Japan; Kawamoto, Nobuyuki, Yamaguchi Univ., Japan; Memoirs of the Faculty of Engineering Yamaguchi University; Oct. 1994; vol. Volume 45, no. No. 1, pp. 39-47; In Japanese; Also announced as 19960052289; Copyright; Avail: Issuing Activity (Faculty of Engineering, Yamaguchi Univ., Ube, Japan), Hardcopy, Microfiche

The dispersion effects of inertia and drag coefficients of a circular cylinder in a sinusoidally oscillating flow is studied at low values of Keulegan-Carpenter's number. Drag and lift forces are simultaneously measured by cantilever beams with four PN semi-conductor gages. Flow visualization around the circular cylinder is accomplished with electrolysis. The drag and resultant force coefficients show a value about 2 times as much as an asymmetric eddy formation at the same K-C number in the case where the eddy is shed symmetrically with respect to a line of mainflow passing through a cylindrical axis. Asymmetric formation of the eddy plays an important role to change the direction and magnitude of the approaching velocity. The formation induces a strong lift and decreases the drag and resultant forces.
Derived from text
Circular Cylinders; Drag; Flow Visualization; Inertia; Lift; Oscillating Flow; Vortices; Flow Coefficients; Force Distribution

19960052294 Yamaguchi Univ., Faculty of Engineering, Ube, Japan
On the Fluid Forces Acting on a Circular Cylinder with a Triangle Rib
Saitou, Takashi, Yamaguchi Univ., Japan; Tawa, Yoshio, Yamaguchi Univ., Japan; Kitajima, Akira, Yamaguchi Univ., Japan; Norikoshi, Akira, Yamaguchi Univ., Japan; Kawamoto, Meiko, Yamaguchi Univ., Japan; Memoirs of the Faculty of Engineering Yamaguchi University; Oct. 1994; vol. Volume 45, no. No. 1, pp. 49-56; In Japanese; Also announced as 19960052289; Copyright; Avail: Issuing Activity (Faculty

of Engineering, Yamaguchi Univ., Ube, Japan), Hardcopy, Microfiche

The Reynolds number effect and the effect of the scale of the rib on a circular cylinder (on the regions where it is located) are observed. The flow distribution was studied. In the case of the bi-stable flow pattern, the pressure distribution along the surface of the circular cylinder is measured in order to confirm that the reattached and separated flow turn alternatively. The Strouhal number, based on the variation on lift force, is small in the case of the re-attached flow and large in the case of separated flow, compared to a circular cylinder without ribs. These values change by the ratio of duration time and flow patterns.

Derived from text

Ribs (Supports); Circular Cylinders; Flow Distribution; Force Distribution; Pressure Distribution; Lift

19960052584 Naval Postgraduate School, Monterey, CA USA

Digital Video Transmission from the P-3C to Beyond Line-of-Sight Destinations

Longhini, John M., Naval Postgraduate School, USA; Scott, Steven J., Naval Postgraduate School, USA; Sep. 1995; 113p; In English

Report No.(s): AD-A305798; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The goal of this thesis is to provide a feasibility analysis concerning the transmission of real time, full motion digital video from a P-3C maritime surveillance aircraft to both line of sight and beyond line of sight destinations. The ability to receive live video on the ground or onboard ship will aid the warfighter in making more timely and correct tactical decisions due to the increased intelligence capabilities. Currently, the capability exists to transmit still frame images over a UHF satellite link to shore installations using specially modified P-3C aircraft. Full motion video can also be transmitted using a hybrid system borrowed from the Pioneer UAV program; however, it is limited to line-of-sight transmission only. Both of these current capabilities utilize an analog format and analog quality resolution. The U.S. Navy has a standing Mission Need Statement for airborne C31. More specifically, there exists a need for improved electro-optical capabilities as well as rapid exchange of command, surveillance, and targeting data with both ships at sea and shore installations. This thesis traces the flow of data from the video source to the ultimate destinations and identifies possible solutions for the design of the transmission link. The fundamental technologies exist now to provide digital full motion video from an aircraft via a high capacity satellite data link. To ensure capability with other DOD communication systems, compliance with Common Data Link (CDL) was incorporated in the proposed system. This thesis proves the proposed video transmission system is technically feasible.

DTIC

P-3 Aircraft; Line of Sight; Data Transmission; Pulse Communication; Video Signals; Electro-Optics; Real Time Operation; Surveillance

19960052649 NASA Lewis Research Center, Cleveland, OH USA

ACTS Aeronautical Terminal Experiment System Description and Link Analysis

Sohn, Philip, NASA Lewis Research Center, USA; Raquet, Charles, NASA Lewis Research Center, USA; Reinhart, Richard, Analex Corp., USA; Nakamura, Dan, Jet Propulsion Lab., California Inst. of Tech., USA; Advanced Communication Technology Satellite Results Conference; May 1996; vol. Part 1; 6p; In English; Also announced as 19960052605; No Copyright; Avail: Issuing Activity (ACTS Project Office, Lewis Research Center, Cleveland, OH 44135), Hardcopy, Microfiche

During the summer of 1994, the performance of an experimental mobile satellite communication system was demonstrated to industry and government representatives by the NASA Lewis Research Center (LeRC) and the Jet Propulsion Laboratory (JPL). The system was based on the advanced communications technology satellite (ACTS) and consisted of a K-/Ka-band active monolithic microwave integrated circuit (MMIC) phased array antenna system, ACTS mobile terminal (AMT) and link evaluation terminal (LET). A LeRC research aircraft, Learjet model 25, was outfitted with the active MMIC phased array antenna system and AMT and served as the experimental 20/30 Ghz aeronautical terminal. The LET at LeRC in Cleveland, OH, was interfaced with portions of fixed-AMT equipment and together provided the gateway station functions including ACTS interface and public service telephone network (PSTN) interface. The ACTS was operated in its microwave switch matrix (MSM) mode with a spot beam for the Learjet and another spot beam dedicated to the LET. The Learjet was flown over several major cities across the US and demonstrated the feasibility of a full-duplex compressed voice links for an aeronautical terminal through the 20/30 Ghz ACTS channel. This paper presents a technical description of the system including the MMIC phased array antenna system, AMT, Learjet, LET, and ACTS. The array antenna system consists of a 30 Ghz transmit array (LeRc/Texas Instruments) and two 20 Ghz receive arrays (USAF Rome Lab., Boeing, and Martin Marietta), each one very small with sufficient performance for a satellite voice link. The AMT consists of 2.4/4.8/9.6 Kbps voice coder/decoder, modem, PSTN interface and RF/IF converters. Link analysis is presented and compared to the actual performance data collected during the demonstration flights.

Author

ACTS; Lear Jet Aircraft; Microwave Circuits; Mobile Communication Systems; Switching Circuits; Phased Arrays; Antenna Arrays; Antenna Design; Airborne Equipment