NASA SP-7037 (314)
February 1995

AERONAUTICAL ENGINEERING

P-71

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(NASA-SP-7037(314)) AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 314) (NASA) 71 p

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A CONTINUING BIBLIOGRAPHY WITH INDEXES

National Aeronautics and Space Administration
Scientific and Technical Information Office
Washington, DC 1995

This publication was prepared by the NASA Center for AeroSpace Information,
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INTRODUCTION

This issue of *Aeronautical Engineering — A Continuing Bibliography with Indexes* (NASA SP-7037) lists 144 reports, journal articles, and other documents recently announced in the NASA STI Database.

Accession numbers cited in this issue include:

Scientific and Technical Aerospace Reports (STAR) (N-10000 Series)	N95-11698 — N95-13609
Open Literature (A-60000 Series)	A95-60780 — A95-61679

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract number, report number, and accession number—are included.

A cumulative index for 1995 will be published in early 1996.

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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TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED
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ACCESSION NUMBER → **N95-10318*#** Dow Chemical Co., Midland, MI. ← CORPORATE SOURCE
TITLE → **NOVEL MATRIX RESINS FOR COMPOSITES FOR AIRCRAFT PRIMARY STRUCTURES, PHASE 1 Final Report, Apr. 1989 - Mar. 1992**
AUTHORS → EDMUND P. WOO, P. M. PUCKETT, S. MAYNARD, M. T. BISHOP, K. J. BRUZA, J. P. GODSCHALX, AND M. J. MULLINS Aug. 1992 ← PUBLICATION DATE
164 p
CONTRACT NUMBERS → (Contracts NAS1-18841; RTOP 510-02-11-02)
REPORT NUMBERS → (NASA-CR-189657; NAS 1.26:189657) Avail: CASI HC A08/MFA02 ← AVAILABILITY AND PRICE CODE

The objective of the contract is the development of matrix resins with improved processability and properties for composites for primarily aircraft structures. To this end, several resins/systems were identified for subsonic and supersonic applications. For subsonic aircraft, a series of epoxy resins suitable for RTM and powder prepreg was shown to give composites with about 40 ksi compressive strength after impact (CAI) and 200 F/wet mechanical performance. For supersonic applications, a thermoplastic toughened cyanate prepreg system has demonstrated excellent resistance to heat aging at 360 F for 4000 hours, 40 ksi CAI and useful mechanical properties at greater than or equal to 310 F. An AB-BCB-maleimide resin was identified as a leading candidate for the HSCT. Composite panels fabricated by RTM show CAI of approximately 50 ksi, 350 F/wet performance and excellent retention of mechanical properties after aging at 400 F for 4000 hours. Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

ACCESSION NUMBER → **A95-60192*** National Aeronautics and Space Administration. Ames. Research Center, Moffett Field, CA. ← CORPORATE SOURCE
TITLE → **AERODYNAMIC INTERACTIONS BETWEEN A ROTOR AND WING IN HOVER**
AUTHORS → FORT F. FELKER NASA. Ames Research Center, Moffett Field, CA, US and JEFFREY S. LIGHT NASA. Ames Research Center, Moffett Field, CA, US ← AUTHOR'S AFFILIATION
Journal of the American Helicopter Society ← JOURNAL TITLE
PUBLICATION DATE → 2 Jun. 1986 p. 53-61
REPORT NUMBER → (HTN-94-00714) Copyright

An experimental investigation of rotor/wing aerodynamic interactions in hover is described. The investigation consisted of both a large-scale and a small-scale test. A 0.658-scale V-22 rotor and wing was used in the large-scale test. Wing download, wing surface pressure, rotor performance, and rotor downwash data from the large-scale test are presented. A small-scale experiment was conducted to determine how changes in the rotor/wing geometry affected the aerodynamic interactions. These geometry variations included the distance between the rotor and wing, wing incidence angle, wing flap angle, rotor rotation direction, and configurations both with the rotor axis at the tip of the wing (tilt rotor configuration) and with the rotor axis at the center of the wing (compound helicopter configuration). Author (Herner)

01

AERONAUTICS (GENERAL)

A95-60852
NOVEL SIMILARITY SOLUTIONS OF THE SONIC SMALL-DISTURBANCE EQUATION WITH APPLICATIONS TO AIRFOIL TRANSONIC AERODYNAMICS
Z. RUSAK Rensselaer Polytechnic Inst., Troy, NY SIAM Journal on Applied Mathematics (ISSN 0036-1399) vol. 54, no. 2 April 1994 p. 285-308 refs
(BTN-94-EIX94341340316) Copyright

Similarity solution of the small-disturbance equation for a two-dimensional near-sonic potential flow are studied. The analysis uses basic similarity solutions of the problem in the hodograph plane. The application of the present solutions to the far-field approximation of a sonic flow about a thin airfoil results in a relation between Frankl's special similarity parameter and the hodograph-similarity variable. The new solutions are also applied to the problem of near-sonic small-disturbance flow. EI

N95-11892 National Academy of Sciences - National Research Council, Washington, DC. Commission on Engineering and Technical Systems.
AERONAUTICS AND SPACE TECHNOLOGY, PAST, PRESENT, AND FUTURE
1994 86 p Proceedings of the 25th Anniversary Symposium of the Aeronautics and Space Engineering Board held 7 May 1993
Copyright Avail: Issuing Activity (The Aeronautics and Space Engineering Board, 2101 Constitution Ave., NW, Washington, DC, 20418)

The topics covered include the following: a national technology strategy; a new role for technology; an Aeronautics and Space Engineering Board (ASEB) historical perspective and lessons learned; a look to the future in aeronautical technologies; setting a course for the future; evolution of technologies for space exploration; space technology as a national resource; and ASEB as advisor to NASA. CASI

N95-12166# National Aerospace Lab., Bangalore (India). Experimental Aerodynamics Div.
EXPERIMENTAL AERODYNAMICS DIVISION Annual Report, 1993
Apr. 1994 83 p
(Contract(s)/Grant(s): NAL PROJ. EA-9-000)
(NAL-SP-9404) Avail: CASI HC A05/MF A01

This annual report covers research and development activities in experimental aerodynamics carried out at the Indian National Trisonic Aerodynamic Facility. Production was doubled in the course of a year with a total of 1600 blowdowns carried out. The effects of pitot probes, angles of attack, vanes, etc., and their locations on the buzz boundaries of air intakes were systematically studied. The studies indicated that pressure fluctuations downstream of retro rockets could be reduced significantly by proper shaping. Other tests determined control surface effectiveness on a missile model. In the area of flow structure and management, research continued on vortex flows on wings and bodies and aerodynamic drag reduction. In the area of aircraft and missile aerodynamics, the MAHAA code was extended to predict drag characteristics on the aerodynamic configurations at trisonic speeds. CASI

N95-12227*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE SELECTIVE USE OF FUNCTIONAL OPTICAL VARIABLES IN THE CONTROL OF FORWARD SPEED
WALTER W. JOHNSON and CYNTHIA A. AWE Sep. 1994 36 p
(Contract(s)/Grant(s): RTOP 505-64-36)
(NASA-TM-108849; A-94139; NAS 1.15:108849) Avail: CASI HC A03/MF A01

Previous work on the perception and control of simulated vehicle speed has examined the contributions of optical flow rate (angular visual speed) and texture, or edge rate (frequency of passing terrain objects or markings) on the perception and control of forward speed. However, these studies have not examined the ability to selectively use edge rate or flow rate. The two studies presented here show that this ability is far greater for pilots than non-pilots, as would be expected since pilots must control vehicular speed over a variety of altitudes where flow rates change independently of forward speed. These studies also show that this ability to selectively use these variables is linked to the visual contextual information about the relative validity (linkage with speed) of the two variables. Subjective judgment data also indicated that awareness of altitude and ground texture density did not mediate ground speed awareness. Author

02

AERODYNAMICS

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

N95-11710*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A SHADOWGRAPH STUDY OF THE NATIONAL LAUNCH SYSTEM'S 1 1/2 STAGE VEHICLE CONFIGURATION AND HEAVY LIFT LAUNCH VEHICLE CONFIGURATION
DARLENE C. POKORA and ANTHONY M. SPRINGER Washington Aug. 1994 89 p
(NASA-RP-1347; M-755; NAS 1.61:1347) Avail: CASI HC A05/MF A01

A shadowgraph study of the National Launch System's (NLS's) 1 1/2 stage and heavy lift launch vehicle (HLLV) configurations is presented. Shadowgraphs are shown for the range of Mach numbers from Mach 0.6 to 5.0 at various angles-of-attack and roll angles. Since the 1 1/2 stage configuration is generally symmetric, no shadowgraphs of any roll angle are shown for this configuration. The major flow field phenomena over the NLS 1 1/2 stage and HLLV configurations are shown in the shadowgraphs. These shadowgraphs are used in the aerothermodynamic analysis of the external flow conditions the launch vehicle would encounter during the ascent stage of flight. The shadowgraphs presented in this study were obtained from configurations tested in the Marshall Space Flight Center's 14-Inch Trisonic Wind Tunnel during 1992. Author

N95-11766*# MCAT Inst., Moffett Field, CA.
PARALLEL AEROELASTIC COMPUTATIONS FOR WING AND WING-BODY CONFIGURATIONS Annual Report, Jul. 1993 - Jul. 1994
CHANSUP BYUN Jul. 1994 62 p Original contains color illustrations
(Contract(s)/Grant(s): NCC2-740)
(NASA-CR-196835; NAS 1.26:196835; MCAT-94-08) Avail: CASI HC A04/MF A01; 6 functional color pages

The objective of this research is to develop computationally efficient methods for solving fluid-structural interaction problems by directly coupling finite difference Euler/Navier-Stokes equations for fluids and finite element dynamics equations for structures on parallel computers. This capability will significantly impact many aerospace projects of national importance such as Advanced Subsonic Civil Transport (ASCT), where the structural stability margin becomes very critical at the transonic region. This research effort will have direct impact on the High Performance Computing and Communication (HPCC) Program of NASA in the area of parallel computing. Derived from text

N95-11807*# Rockwell International Corp., Huntsville, AL. Space Systems Div.
HIGH FREQUENCY FLOW/STRUCTURAL INTERACTION IN DENSE SUBSONIC FLUIDS HANDBOOK Final Report
BAW-LIN LIU and J. M. OFARRELL Jul. 1994 217 p
(Contract(s)/Grant(s): NAS8-38187)
(NASA-CR-194007; NAS 1.26:194007) Avail: CASI HC A10/MF A03

Prediction of the detailed dynamic behavior of structural elements in rocket propellant feed systems and engines and other such high-energy fluid systems requires precise analysis to assure structural performance. Designs sometimes require placement of bluff bodies in a flow passage. Additionally, there are flexibilities in ducts, liners, and piping systems. A design handbook and iterative data base have been developed for assessing flow/structural interactions as a quick and ready reference to be used as a tool in design and development, to evaluate applicable geometries before problems develop, or to eliminate or minimize problems with existing hardware. Organization of the handbook is by basic geometric shapes for estimating Strouhal numbers, added mass effects, mode shapes for various end constraints, critical onset flow conditions, and possible structural response amplitudes. Emphasis is on dense fluids and high structural loading potentials for fatigue at low subsonic flow speeds where high-frequency excitations are possible. Avoidance and corrective measure illustrations are presented together with analytical curve fits for prediction compiled from a comprehensive data base. Author

N95-11829 Wright Lab., Wright-Patterson AFB, OH.
PRESSURE MEASUREMENTS ON AN F/A-18 TWIN VERTICAL TAIL IN BUFFETING FLOW. VOLUME 3: BUFFET POWER SPECTRAL DENSITIES Final Report, 1 Apr. 1993 - 1 Aug. 1994
CHRIS PETTIT, DANSEN BROWN, MICHAEL BANFORD, and ED PENDLETON Aug. 1994 705 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): AF PROJ. 2401)
(AD-A281444; WL-TM-94-3066-VOL-3) Avail: CASI HC A99

Buffeting pressure measurements were made on the vertical tail surface of a full scale F/A-18 aircraft model in the National Full Scale Aerodynamics Complex at NASA Ames Research Center. Test variables included aircraft angle-of-attack, aircraft sideslip angle, and dynamic pressure. Accelerometers were used to obtain vertical tail accelerations. Pressure transducers were mounted on the starboard vertical tail. Steady and unsteady pressures were obtained. Unsteady pressure data were reduced to PSD and CSD forms. Both steady and unsteady RMS pressure coefficients are also presented. Volume 1 contains the general description of the model, the test program, and highlights of the reduced data. Volume 2 contains steady and unsteady RMS data. Volume 3 contains unsteady PSD results. Volume 4 contains unsteady CSD results. DTIC

N95-11877*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
OPTIMUM AERODYNAMIC DESIGN VIA BOUNDARY CONTROL
ANTONY JAMESON (Princeton Univ., NJ.) Aug. 1994 35 p
Sponsored in part by IBM
(Contract(s)/Grant(s): NAS2-13721; N00014-92-J-1976; AF-AFOSR-0391-91)
(NASA-CR-195882; NAS 1.26:195882; RIACS-TR-94-17) Avail: CASI HC A03/MF A01

These lectures describe the implementation of optimization techniques based on control theory for airfoil and wing design. In previous studies it was shown that control theory could be used to devise an effective optimization procedure for two-dimensional profiles in which the shape is determined by a conformal transformation from a unit circle, and the control is the mapping function. Recently the method has been implemented in an alternative formulation which does not depend on conformal mapping, so that it can more easily be extended to treat general configurations. The method has also been extended to treat the Euler equations, and results are presented for both two and three dimensional cases, including the optimization of a swept wing. Author

N95-11884*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
CONTROL THEORY BASED AIRFOIL DESIGN USING THE EULER EQUATIONS
ANTONY JAMESON (Princeton Univ., NJ.) and JAMES REUTHER Sep. 1994 19 p
(Contract(s)/Grant(s): NAS2-13721; AF-AFOSR-0391-91)
(NASA-CR-196360; NAS 1.26:196360; RIACS-TR-94-18) Avail: CASI HC A03/MF A01

This paper describes the implementation of optimization techniques based on control theory for airfoil design. In our previous work it was shown that control theory could be employed to devise effective optimization procedures for two-dimensional profiles by using the potential flow equation with either a conformal mapping or a general coordinate system. The goal of our present work is to extend the development to treat the Euler equations in two-dimensions by procedures that can readily be generalized to treat complex shapes in three-dimensions. Therefore, we have developed methods which can address airfoil design through either an analytic mapping or an arbitrary grid perturbation method applied to a finite volume discretization of the Euler equations. Here the control law serves to provide computationally inexpensive gradient information to a standard numerical optimization method. Results are presented for both the inverse problem and drag minimization problem. Author

N95-11898*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
WATER TUNNEL FLOW VISUALIZATION STUDY OF A 4.4 PERCENT SCALE X-31 FOREBODY
BRENT R. COBLEIGH and JOHN DELFRATE Washington Sep. 1994 40 p Original contains color illustrations
(Contract(s)/Grant(s): RTOP 533-02-00)
(NASA-TM-104276; H-1997; NAS 1.15:104276) Avail: CASI HC A03/MF A01; 22 functional color pages

A water-tunnel test of a 4.4 percent-scale, forebody-only model of the X-31 aircraft with different forebody strakes and noseboons has been performed in the Flow Visualization Facility at the NASA Dryden Flight Research Center. The focus of the study was to determine the relative effects of the different configurations on the stability and symmetry of the high-angle-of-attack forebody vortex flow field. The clean, noseboom-off configuration resisted the development of asymmetries in the primary vortices through 70 deg angle of attack. The wake of the X-31 flight test noseboom configuration significantly degraded the steadiness of the primary vortex cores and promoted asymmetries. An alternate L-shaped noseboom mounted underneath the forebody had results similar to those seen with the configuration, enabling stable, symmetrical vortices up to 70 deg angle of attack. The addition of strakes near the radome tip along the waterline increased the primary vortex strength while it simultaneously caused the vortex breakdown location co move forward. Forebody strakes did not appear to significantly reduce the asymmetries in the forebody vortex field in the presence of the flight test noseboom. Author

N95-11911*# California Univ., Los Angeles, CA. Dept. of Mechanical, Aerospace and Nuclear Engineering.
AEROELASTIC SIMULATION OF HIGHER HARMONIC CONTROL
LAWSON H. ROBINSON and PERETZ P. FRIEDMANN Moffett Field, CA NASA Aug. 1994 301 p
(Contract(s)/Grant(s): NAG2-477)
(NASA-CR-4623; A-94118; NAS 1.26:4623) Avail: CASI HC A14/MF A03

This report describes the development of an aeroelastic analysis of a helicopter rotor and its application to the simulation of helicopter vibration reduction through higher harmonic control (HHC). An improved finite-state, time-domain model of unsteady aerodynamics is developed to capture high frequency aerodynamic effects. An improved trim procedure is implemented which accounts for flap, lead-lag, and torsional deformations of the blade. The effect of unsteady aerodynamics is studied and it is found that its impact on blade aeroelastic stability and low frequency response is small, but it has a significant influence on rotor hub vibrations. Several different HHC algorithms are implemented on a hingeless rotor and their effectiveness in reducing hub vibratory shears is compared. All the controllers are found to be quite effective, but very differing HHC inputs are required depending on the aerodynamic model used. Effects of HHC on rotor stability and power requirements are found to be quite small. Simulations of roughly equivalent articulated and hingeless rotors are carried out, and it is found that hingeless rotors can require considerably larger HHC inputs to reduce vibratory shears. This implies that the practical implementation of HHC on hingeless rotors might be considerably more difficult than on articulated rotors. Author

N95-11917*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MODIFICATION OF THE TWO-EQUATION TURBULENCE MODEL IN NPARC TO A CHIEN LOW REYNOLDS NUMBER K-EPSILON FORMULATION
NICHOLAS J. GEORGIADIS, TAWIT CHITSOMBOON, and JIANG ZHU Sep. 1994 19 p
(Contract(s)/Grant(s): NCC3-233; RTOP 537-02-23)
(NASA-TM-106710; ICOMP-94-20; E-9072; NAS 1.15:106710; CMOTT-94-5) Avail: CASI HC A03/MF A01

This report documents the changes that were made to the two-equation k-epsilon turbulence model in the NPARC (National-PARC) code. The previous model based on the low Reynolds number model of Speziale, was replaced with the low Reynolds number k-epsilon model of Chien. The most significant difference was in the turbulent Prandtl numbers appearing in the diffusion terms of the k and epsilon transport equations. A new inflow boundary condition and stability enhancements were also implemented into the turbulence model within NPARC. The report provides the rationale for making the change to the Chien model, code modifications required, and comparisons of the performances of the new model with the previous k-epsilon model and algebraic models used most often in PARC/NPARC. The comparisons show that the Chien k-epsilon model installed here improves the capability of NPARC to calculate turbulent flows. Author (revised)

N95-11927*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
NUMERICAL ANALYSIS OF TANGENTIAL SLOT BLOWING ON A GENERIC CHINED FOREBODY
ROXANA M. AGOSTA Sep. 1994 59 p
(Contract(s)/Grant(s): RTOP 505-68-00)
(NASA-TM-108845; A-94125; NAS 1.15:108845) Avail: CASI HC A04/MF A01

A numerical study is performed to investigate the effects of tangential slot blowing on a generic chined forebody. The Reynolds-averaged, thin-layer, Navier-Stokes equations are solved to obtain the high-angle-of-attack viscous flow field about a generic chined forebody. Tangential slot blowing is investigated as a means of forebody flow control to generate side force and yawing moment on the forebody. The effects of jet mass flow ratios, angle of attack, and blowing slot location in the axial and circumferential directions are studied. The computed results are compared with available wind tunnel experimental data. The solutions with and without blowing are also analyzed using helicity density contours, surface flow patterns, and off-surface instantaneous streamlines. The results of this analysis provide details of the flow field about the generic chined forebody, as well as show that tangential slot blowing can be used as a means of forebody flow control to generate side force and yawing moment. Author

N95-11967*# Eloret Corp., Palo Alto, CA.
COMPUTATIONAL FLOW PREDICTIONS FOR HYPERSONIC DRAG DEVICES
SUSAN A. TOKARCIK and ETHIRAJ VENKATAPATHY *In* NASA. Ames Research Center, Technical Paper Contest for Women 1992. Space Challenges: Earth and Beyond p 145-170 1993
Avail: CASI HC A03/MF A03

The effectiveness of two types of hypersonic decelerators is examined: mechanically deployable flares and inflatable ballutes. Computational fluid dynamics (CFD) is used to predict the flowfield around a solid rocket motor (SRM) with a deployed decelerator. The computations are performed with an ideal gas solver using an effective specific heat ratio of 1.15. The results from the ideal gas solver are compared to computational results from a thermochemical nonequilibrium solver. The surface pressure coefficient, the drag, and the extend of the compression corner separation zone predicted by the ideal gas solver compare well with those predicted by the nonequilibrium solver. The ideal gas solver is computationally inexpensive and is shown to be well suited for preliminary design studies. The computed solutions are used to determine the size and shape of the decelerator that are required to achieve a drag coefficient of 5. Heat transfer rates to the SRM and the decelerators are predicted to estimate the amount of thermal protection required. Author

N95-11995*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPUTER CODE FOR DETERMINATION OF THERMALLY PERFECT GAS PROPERTIES
DAVID W. WITTE and KENNETH E. TATUM Sep. 1994 77 p
(Contract(s)/Grant(s): RTOP 505-70-59-03)
(NASA-TP-3447; L-17327; NAS 1.60:3447) Avail: CASI HC A05/MF A01

A set of one-dimensional compressible flow relations for a thermally perfect, calorically imperfect gas is derived for the specific heat c(sub p), expressed as a polynomial function of temperature, and developed into the thermally perfect gas (TPG) computer code. The code produces tables of compressible flow properties similar to those of NACA Rep. 1135. Unlike the tables of NACA Rep. 1135 which are valid only in the calorically perfect temperature regime, the TPG code results are also valid in the thermally perfect calorically imperfect temperature regime which considerably extends the range of temperature application. Accuracy of the TPG code in the calorically perfect temperature regime is verified by comparisons with the tables of NACA Rep. 1135. In the thermally perfect, calorically imperfect temperature regime, the TPG code is validated by comparisons with results obtained from the method of NACA Rep. 1135 for calculating the thermally perfect calorically imperfect compressible flow properties. The temperature limits for application of the TPG code are also examined. The advantage of the TPG code is its applicability to any type of gas (monatomic, diatomic, triatomic, or

polyatomic) or any specified mixture thereof, whereas the method of NACA Rep. 1135 is restricted to only diatomic gases.
Author (revised)

N95-12176*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
APPLICATION OF TWO PROCEDURES FOR DUAL-POINT DESIGN OF TRANSONIC AIRFOILS
RAYMOND E. MINECK, RICHARD L. CAMPBELL, and DENNIS O. ALLISON Sep. 1994 53 p
(Contract(s)/Grant(s): RTOP 505-59-54-17)
(NASA-TP-3466; L-17268; NAS 1.60:3466) Avail: CASI HC A04/MF A01

Two dual-point design procedures were developed to reduce the objective function of a baseline airfoil at two design points. The first procedure to develop a redesigned airfoil used a weighted average of the shapes of two intermediate airfoils redesigned at each of the two design points. The second procedure used a weighted average of two pressure distributions obtained from an intermediate airfoil redesigned at each of the two design points. Each procedure was used to design a new airfoil with reduced wave drag at the cruise condition without increasing the wave drag or pitching moment at the climb condition. Two cycles of the airfoil shape-averaging procedure successfully designed a new airfoil that reduced the objective function and satisfied the constraints. One cycle of the target (desired) pressure-averaging procedure was used to design two new airfoils that reduced the objective function and came close to satisfying the constraints.
Author

N95-12191*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.
DYNAMIC GROUND EFFECTS FLIGHT TEST OF AN F-15 AIRCRAFT
STEPHEN CORDA (Planning Research Corp., Edwards, CA.), MARK T. STEPHENSON, FRANK W. BURCHAM, and ROBERT E. CURRY Washington Sep. 1994 28 p
(Contract(s)/Grant(s): RTOP 533-02-31)
(NASA-TM-4604; H-1999; NAS 1.15:4604) Avail: CASI HC A03/MF A01

Flight tests to determine the changes in the aerodynamic characteristics of an F-15 aircraft caused by dynamic ground effects are described. Data were obtained for low and high sink rates between 0.7 and 6.5 ft/sec and at two landing approach speeds and flap settings: 150 kn with the flaps down and 170 kn with the flaps up. Simple correlation curves are given for the change in aerodynamic coefficients because of ground effects as a function of sink rate. Ground effects generally caused an increase in the lift, drag, and nose-down pitching movement coefficients. The change in the lift coefficient increased from approximately 0.05 at the high-sink rate to approximately 0.10 at the low-sink rate. The change in the drag coefficient increased from approximately 0 to 0.03 over this decreasing sink rate range. No significant difference because of the approach configuration was evident for lift and drag; however, a significant difference in pitching movement was observed for the two approach speeds and flap settings. For the 170 kn with the flaps up configuration, the change in the nose-down pitching movement increased from approximately -0.008 to -0.016. For the 150 kn with the flaps down configuration, the change was approximately -0.008 to -0.038.
Author

N95-12360*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MEASUREMENTS OF ATMOSPHERIC TURBULENCE EFFECTS ON TAIL ROTOR ACOUSTICS Final Report
MARTIN J. HAGEN (California Polytechnic State Univ., San Luis Obispo, CA.), GLORIA K. YAMAUCHI, DAVID B. SIGNOR, and MARIANNE MOSHER Sep. 1994 81 p
(Contract(s)/Grant(s): RTOP 505-59-36)
(NASA-TM-108843; A-94122; NAS 1.15:108843) Avail: CASI HC A05/MF A01

Results from an outdoor hover test of a full-scale Lynx tail rotor are presented. The investigation was designed to further the understanding of the acoustics of an isolated tail rotor hovering out-of-ground effect in atmospheric turbulence, without the effects of the main rotor wake or other helicopter components. Measurements include simultaneous rotor performance, noise, inflow, and far-field atmospheric turbulence. Results with grid-generated inflow turbulence are also presented. The effects of atmospheric turbulence ingestion on rotor noise are quantified. In contradiction to current theories, increasing rotor inflow and rotor thrust were found to increase turbulence ingestion noise. This is the final report of Task 13A—Helicopter Tail Rotor Noise, of the NASA/United Kingdom Defense Research Agency cooperative Aeronautics Research Program.
Author

N95-12378*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A NEW ALGORITHM FOR FIVE-HOLE PROBE CALIBRATION, DATA REDUCTION, AND UNCERTAINTY ANALYSIS
BRUCE A. REICHERT and BRUCE J. WENDT Sep. 1994 21 p
(Contract(s)/Grant(s): RTOP 505-62-52)
(NASA-TM-106458; E-8319; NAS 1.15:106458) Avail: CASI HC A03/MF A01

A new algorithm for five-hole probe calibration and data reduction using a non-nulling method is developed. The significant features of the algorithm are: (1) two components of the unit vector in the flow direction replace pitch and yaw angles as flow direction variables; and (2) symmetry rules are developed that greatly simplify Taylor's series representations of the calibration data. In data reduction, four pressure coefficients allow total pressure, static pressure, and flow direction to be calculated directly. The new algorithm's simplicity permits an analytical treatment of the propagation of uncertainty in five-hole probe measurement. The objectives of the uncertainty analysis are to quantify uncertainty of five-hole results (e.g., total pressure, static pressure, and flow direction) and determine the dependence of the result uncertainty on the uncertainty of all underlying experimental and calibration measurands. This study outlines a general procedure that other researchers may use to determine five-hole probe result uncertainty and provides guidance to improve measurement technique. The new algorithm is applied to calibrate and reduce data from a rake of five-hole probes. Here, ten individual probes are mounted on a single probe shaft and used simultaneously. Use of this probe is made practical by the simplicity afforded by this algorithm.
Author

N95-12389*# MCAT Inst., San Jose, CA.
HIGH SPEED CIVIL TRANSPORT AERODYNAMIC OPTIMIZATION Annual Report, Aug. 1993 - Jul. 1994
JAMES S. RYAN Jul. 1994 6 p Original contains color illustrations
(Contract(s)/Grant(s): NCC2-796)
(NASA-CR-196960; NAS 1.26:196960) Avail: CASI HC A02/MF A01; 1 functional colored page

This is a report of work in support of the Computational Aerosciences (CAS) element of the Federal HPCC program. Specifically, CFD and aerodynamic optimization are being performed on parallel computers. The long-range goal of this work is to facilitate teraflops-rate multidisciplinary optimization of aerospace vehicles. This year's work is targeted for application to the High Speed Civil Transport (HSCT), one of four CAS grand challenges identified in the HPCC FY 1995 Blue Book. This vehicle is to be a passenger aircraft, with the promise of cutting overseas flight time by more than half. To meet fuel economy, operational costs, environmental impact, noise production, and range requirements, improved design tools are required, and these tools must eventually integrate optimization, external aerodynamics, propulsion, structures, heat transfer, controls, and perhaps other disciplines. The fundamental goal of this project is to contribute to improved design tools for U.S. industry, and thus to the nation's economic competitiveness.
Derived from text

N95-12548 Air Force Inst. of Tech., Wright-Patterson AFB, OH.
MEASUREMENTS OF PRESSURE AND THERMAL WAKES IN A TRANSONIC TURBINE CASCADE M.S. Thesis
ALEXIS MEZYNSKI Aug. 1994 80 p Limited Reproducibility:

More than 20% of this document may be affected by microfiche quality
(AD-A283464; AFIT/CI/CIA-94-118) Avail: CASI HC A05

The effects of freestream turbulence on the total pressure and total temperature in the wake of a cooled transonic turbine cascade with heated flow are presented in this thesis. The experiment was conducted in the Virginia Tech Cascade Wind Tunnel. A dual hot wire aspirating probe was used to make high frequency, unsteady total pressure and temperature measurements. The probe design was modified to be used in a high temperature environment. The flow was heated to temperatures exceeding 140 deg C and the turbine blades were actively cooled using gaseous nitrogen to maintain a gas to blade temperature ratio between 1.3 and 1.4. A turbulence screen was used to change the freestream turbulence from 3.3% to 7.5%. Mean and turbulent total pressure and temperature quantities are presented. The higher freestream turbulence resulted in lower total pressure and total temperature turbulence intensifies in the wakes of the turbine blades. The freestream turbulence level had no measurable effect on the blade losses. DTIC

N95-12578 Institut Franco-Allemand de Recherches, Saint-Louis (France).
SUPERSONIC BASE FLOW INVESTIGATION OVER AXISYMMETRIC AFTERBODIES
C. BERNER 1993 13 p Presented at the 5th Conference on Laser Anemometry - Advances and Applications, Veldhoven, Netherlands, 23-27 Aug. 1993 Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France and Centre de Documentation de l'Armement
(PB94-180957; ISL-PU-347/93) Avail: Issuing Activity (National Technical Information Service (NTIS))

Experimental and computational investigations were carried out to study base flows behind afterbodies embedded in a supersonic freestream. Experiments were conducted in a blowdown wind tunnel at a nominal Mach number of 2.06 and for an angle of attack of zero degree. Afterbody models are interchangeable and sting mounted to avoid interference on the base from usual support systems. The experimental study consisted of two axisymmetric afterbodies, a cylindrical afterbody and a tapered afterbody with a conical boattail of 6 degrees and a boattail length of one diameter. Results include flow visualization, static wall pressure distributions and turbulent flow properties obtained by means of a two-dimensional laser Doppler velocimeter (LDV). Computations were carried out using a multi-dimensional Navier-Stokes code based upon a fully implicit, combined finite volume/flux element discretization approach with a standard K-epsilon turbulence model. Computed solutions show some good agreement with experiment as far as concerning the flow field structure, surface and base pressures but show some deficiencies with velocities and shear stress correlations. NTIS

N95-12652# Los Alamos National Lab., NM.
HYPERSONIC GAS-SURFACE ENERGY ACCOMMODATION TEST FACILITY
J. B. CROSS, M. A. HOFFBAUER, and S. R. COOK 1994 20 p Presented at the 6th AIAA/ASME Thermophysics and Heat Transfer Conference, Colorado Springs, CO, 20-23 Jun. 1994
(Contract(s)/Grant(s): W-7405-ENG-36)
(DE94-014468; LA-UR-94-2080; CONF-940625-7) Avail: CASI HC A03/MF A01

A test facility is described that determines energy and momentum accommodation coefficients by direct measurement. Momentum accommodation coefficients are obtained by measuring the force exerted on surfaces by molecular beams using a torsion balance. Energy accommodation coefficients are obtained through the measurement of angular and velocity distributions of the molecules reflected off the scattering surface. Data obtained from the recoil angular and velocity distribution measurements are also used to calculate momentum accommodation coefficients which are then compared to the results obtained from the torsion balance. Results from a torsion balance measurement of 1.5 km/sec N2 scattered from solar cell cover plate material are shown. DOE

N95-12770* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EXPERIMENTAL AERODYNAMIC CHARACTERISTICS OF A GENERIC HYPERSONIC ACCELERATOR CONFIGURATION AT MACH NUMBERS 1.5 AND 2.0
IRA J. WALKER (Lockheed Engineering and Sciences Co., Hampton, VA.), PETER F. COVELL, and DANA K. FORREST Mar. 1993 124 p Non-standard MF as supplement
(Contract(s)/Grant(s): RTOP 505-59-40-10)
(NASA-TM-4413; L-17105; NAS 1.15:4413) Avail: CASI HC A06/ MF A02

An experimental investigation of the static longitudinal and lateral-directional aerodynamic characteristics of a generic hypersonic research vehicle was conducted in the Langley Unitary Plan Wind Tunnel (UPWT). A parametric study was performed to determine the interference effects of various model components. Configuration variables included delta and trapezoidal canards; large and small centerline-mounted vertical tails, along with a set of wing-mounted vertical tails; and a set of model noses with different degrees of bluntness. Wing position was varied by changing the longitudinal location and the incidence angle. The test Mach numbers were 1.5 and 2.0 at Reynolds numbers of 1 x 10(exp 6) per foot, 2 x 10(exp 6) per foot, and 4 x 10(exp 6) per foot. Angle of attack was varied from -4 degrees to 27 degrees, and sideslip angle was varied from -8 degrees to 8 degrees. Generally, the effect of Reynolds number did not deviate from conventional trends. The longitudinal stability and lift-curve slope decreased with increasing Mach number. As the wing was shifted rearward, the lift-curve slope decreased and the longitudinal stability increased. Also, the wing-mounted vertical tails resulted in a more longitudinally stable configuration. In general, the lift-drag ratio was not significantly affected by vertical-tail arrangement. The best lateral-directional stability was achieved with the large centerline-mounted tail, although the wing-mounted vertical tails exhibited the most favorable characteristics at the higher angles of attack. Author (revised)

N95-13058*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
VALIDATION OF THE RPLUS3D CODE FOR SUPERSONIC INLET APPLICATIONS INVOLVING THREE-DIMENSIONAL SHOCK WAVE-BOUNDARY LAYER INTERACTIONS
KAMLESH KAPOOR, BERNHARD H. ANDERSON, and ROBERT J. SHAW Sep. 1994 17 p Original contains color illustrations
(Contract(s)/Grant(s): RTOP 537-02-23)
(NASA-TM-106579; E-8839; NAS 1.15:106579) Avail: CASI HC A03/MF A01; 2 functional color pages

A three-dimensional computational fluid dynamics code, RPLUS3D, which was developed for the reactive propulsive flows of ramjets and scramjets, was validated for glancing shock wave-boundary layer interactions. Both laminar and turbulent flows were studied. A supersonic flow over a wedge mounted on a flat plate was numerically simulated. For the laminar case, the static pressure distribution, velocity vectors, and particle traces on the flat plate were obtained. For turbulent flow, both the Baldwin-Lomax and Chien two-equation turbulent models were used. The static pressure distributions, pitot pressure, and yaw angle profiles were computed. In addition, the velocity vectors and particle traces on the flat plate were also obtained from the computed solution. Overall, the computed results for both laminar and turbulent cases compared very well with the experimentally obtained data. Author

N95-13197*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ROLE OF WIND TUNNELS AND COMPUTER CODES IN THE CERTIFICATION AND QUALIFICATION OF ROTORCRAFT FOR FLIGHT IN FORECAST ICING
ROBERT J. FLEMMING (United Technologies Corp., Stratford,

CT.), RANDALL K. BRITTON (NYMA, Inc., Brook Park, OH.), and THOMAS H. BOND Oct. 1994 23 p Presented at the 20th European Rotorcraft Forum, Amsterdam, The Netherlands, 4-7 Oct. 1994; sponsored by the National Aerospace Laboratory NLR
(Contract(s)/Grant(s): NAS3-27186; RTOP 505-68-10)
(NASA-TM-106747; E-9159; NAS 1.15:106747) Avail: CASI HC A03/MF A01

The cost and time to certify or qualify a rotorcraft for flight in forecast icing has been a major impediment to the development of ice protection systems for helicopter rotors. Development and flight test programs for those aircraft that have achieved certification or qualification for flight in icing conditions have taken many years, and the costs have been very high. NASA, Sikorsky, and others have been conducting research into alternative means for providing information for the development of ice protection systems, and subsequent flight testing to substantiate the air-worthiness of a rotor ice protection system. Model rotor icing tests conducted in 1989 and 1993 have provided a data base for correlation of codes, and for the validation of wind tunnel icing test techniques. This paper summarizes this research, showing test and correlation trends as functions of cloud liquid water content, rotor lift, flight speed, and ambient temperature. Molds were made of several of the ice formations on the rotor blades. These molds were used to form simulated ice on the rotor blades, and the blades were then tested in a wind tunnel to determine flight performance characteristics. These simulated-ice rotor performance tests are discussed in the paper. The levels of correlation achieved and the role of these tools (codes and wind tunnel tests) in flight test planning, testing, and extension of flight data to the limits of the icing envelope are discussed. The potential application of simulated ice, the NASA LEWICE computer, the Sikorsky Generalized Rotor Performance aerodynamic computer code, and NASA Icing Research Tunnel rotor tests in a rotorcraft certification or qualification program are also discussed. The correlation of these computer codes with tunnel test data is presented, and a procedure or process to use these methods as part of a certification or qualification program is introduced.
Author (revised)

N95-13250 Technische Univ., Delft (Netherlands).
STUDIES ON THE FLOW INDUCED BY AN OSCILLATING AIRFOIL IN A UNIFORM STREAM Ph.D. Thesis
Z. WANG 8 Mar. 1994 198 p
PB94-204450; ISBN-90-6275-963-7) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

The thesis is organized into six chapters. Chapter 1 provides an introduction to the problem of oscillating airfoils. In chapter 2 a review of the classical unsteady airfoil theory is given. A survey of viscous flow structure is presented in chapter 3. Experimental studies are described in chapter 4. The experimental study consists of two parts, namely, experimental measurements and numerical calculations based on a panel method which is discussed in detail in chapter 5. Conclusions are summarized in chapter 6. NTIS

03
AIR TRANSPORTATION AND SAFETY

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

N95-12146# Civil Aeromedical Inst., Oklahoma City, OK.
THE PERFORMANCE OF CHILD RESTRAINT DEVICES IN TRANSPORT AIRPLANE PASSENGER SEATS Final Report
VAN GOWDY and RICHARD DEWEESE Sep. 1994 32 p
(DOT/FAA/AM-94/19) Avail: CASI HC A03/MF A01

The performance of child restraint devices (CRD's) in commercial transport airplane passenger seats was evaluated by a dynamic impact test program. Background information on the policies and regulations related to child restraints is summarized. Tests were conducted at the FAA Civil Aeromedical Institute, Six types (CRD's) certified for use in airplanes were tested. Booster seats, forward facing carriers, aft facing carriers, a harness device, a belly belt, and passenger seat lap belts were evaluated. Impact tests were conducted with CRD's installed on airplane passenger seats. The test severity was 16 Gpk with an impact velocity of 44 ft/sec. Effects of multiple row seats, aft row occupant impact loads, and seat back breakover were part of the project protocol. Four child size anthropomorphic test dummies were utilized. The 6-month and 36-month size ATD's defined in 49 CFR Part 572, the 6-month size CRABI ATD, and a 24-month size experimental ATD identified as CAMIX were used in these tests. An experimental device to measure abdominal pressure was evaluated in the CRABI and CAMIX ATD's. Analyses of the data acquired from the tests and observations related to the performance of the CRD's in airplane seats are presented. Author

N95-12499# Southwest Research Inst., San Antonio, TX. Fuels and Lubricants Research Facility.
A STUDY OF AIRCRAFT POST-CRASH FUEL FIRE MITIGATION Interim Report, Jul. 1991 - Feb. 1993
D. W. NAEGELI, B. R. WRIGHT, and D. M. ZALLEN Jun. 1994 38 p
(Contract(s)/Grant(s): DAAK70-87-C-0043; DAAK70-92-C-0059)
(AD-A282208; BFLRF-292) Avail: CASI HC A03/MF A01

Extensive research has been conducted on methods of controlling aircraft post-impact fuel fires. Mechanism studies of hydrocarbon fuel ignition and flame propagation have identified feasible approaches to agent selection and dispersal schemes. Selection of agents is closely controlled by guidelines of the Montreal Protocol Agreements and allowable agent manufacturing as specified by the Environmental Protection Agency. Effectiveness of agents has been determined under a variety of laboratory test conditions. Mass transport of the inerting agent into the vapor above the fuel as well as the environmental conditions in the vapor space play an important role in inerting agent effectiveness. Schemes to control hydrocarbon vapor and to enhance inerting agent effectiveness are discussed.
DTIC

N95-12623 Carnegie-Mellon Inst. of Research, Pittsburgh, PA.
DEVELOPMENT OF AN AUTOMATED NONDESTRUCTIVE INSPECTION (ANDI) SYSTEM FOR COMMERCIAL AIRCRAFT, PHASE 1 Final Report, 15 May 1992 - 31 Jan. 1993
C. J. ALBERTS, W. M. KAUFMAN, and M. W. SIEGEL Jun. 1994 50 p Sponsored by FAA Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A283500; DOT/FAA/CT-94/23-PHASE-1) Avail: CASI HC A03

This report describes the first phase in the development of a robotic system designed to assist aircraft inspectors by remotely deploying nondestructive inspection (NDI) sensors and acquiring, processing, and storing inspection data. To demonstrate the feasibility of using robots to acquire data, a prototype inspection system was developed. The system comprises a surface-walking robot for sensor deployment and a personal computer for controlling the robot and for processing and displaying the acquired data. The robot can deploy an eddy current sensor on the skin surface, scan a portion of a rivet row, and step to another location to gather more data. In addition, requirements to include video cameras to provide visual images of the surface were specified. The prototype system was tested in a laboratory setting on a simulated aircraft panel. The design of the robot satisfied the mobility and manipulation requirements of the skin inspection application. The eddy current traces displayed on the computer monitor from the robotically deployed eddy current sensor were comparable to those from manually deployed eddy current sensors. Overall, the results of this phase of work indicate that robotic inspection tools designed to assist human inspectors hold great promise. DTIC

N95-13203*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AIRBORNE WINDSHEAR DETECTION AND WARNING SYSTEMS. FIFTH AND FINAL COMBINED MANUFACTURERS' AND TECHNOLOGISTS' CONFERENCE, PART 2
VICTOR E. DELNORE, comp. (Lockheed Engineering and Sciences Co., Hampton, VA.) Jul. 1994 426 p Conference held in Hampton, VA, 28-30 Sep. 1993; cosponsored by FAA Prepared in cooperation with FAA, Washington, DC
(Contract(s)/Grant(s): RTOP 505-64-12-01)
(NASA-CP-10139-PT-2; NAS 1.55:10139-PT-2; DOT/FAA/RD-94/14-PT-2) Avail: CASI HC A19/MF A04

The Fifth Combined Manufacturers' and Technologists' Airborne Windshear Review Meeting was hosted by the NASA Langley Research Center and the Federal Aviation Administration in Hampton, Virginia, on September 28-30, 1993. The purpose was to report on the highly successful windshear experiments conducted by government, academic institutions, and industry; to transfer the results to regulators, manufacturers, and users; and to set initiatives for future aeronautics technology research. The formal sessions covered recent developments in windshear flight testing, windshear modeling, flight management, and ground-based systems, airborne windshear detection systems, certification and regulatory issues, and development and applications of sensors for wake vortices and for synthetic and enhanced vision systems. This report was compiled to record and make available the technology updates and materials from the conference. For individual titles, see N95-13204 through N95-13215.

N95-13204*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
WINDSHEAR CERTIFICATION DATA BASE FOR FORWARD-LOOK DETECTION SYSTEMS
GEORGE F. SWITZER (Research Triangle Inst., Hampton, VA.), DAVID A. HINTON, and FRED H. PROCTOR *In its* Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 447-461 Jul. 1994
Avail: CASI HC A03/MF A04

Described is an introduction to a comprehensive database that is to be used for certification testing of airborne forward-look windshear detection systems. The database was developed by NASA Langley Research Center, at the request of the Federal Aviation Administration (FAA), to support the industry initiative to certify and produce forward-looking windshear detection equipment. The database contains high-resolution three-dimensional fields for meteorological variables that may be sensed by forward-looking systems. The database is made up of seven case studies that are generated by the Terminal Area Simulation System, a state-of-the-art numerical system for the realistic modeling of windshear phenomena. The selected cases contained in the certification documentation represent a wide spectrum of windshear events. The database will be used with vendor-developed sensor simulation software and vendor-collected ground-clutter data to demonstrate detection performance in a variety of meteorological conditions using NASA/FAA pre-defined path scenarios for each of the certification cases. A brief outline of the contents and sample plots from the database documentation are included. These plots show fields of hazard factor, or F-factor (Bowles 1990), radar reflectivity, and velocity vectors on a horizontal plane overlayed with the applicable certification paths. For the plot of the F-factor field the region of 0.105 and above signify an area of hazardous, performance decreasing windshear, while negative values indicate regions of performance increasing windshear. The values of F-factor are based on 1-Km averaged segments along horizontal flight paths, assuming an air speed of 150 knots (approx. 75 m/s). The database has been released to vendors participating in the certification process. The database and associated document have been transferred to the FAA for archival storage and distribution. Author (revised)

N95-13205*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CERTIFICATION METHODOLOGY APPLIED TO THE NASA EXPERIMENTAL RADAR SYSTEM
CHARLES L. BRITT (Research Triangle Inst., Hampton, VA.), GEORGE F. SWITZER (Research Triangle Inst., Hampton, VA.), and EMEDIO M. BRACALENTE *In its* Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 463-488 Jul. 1994
Avail: CASI HC A03/MF A04

The objective of the research is to apply selected FAA certification techniques to the NASA experimental wind shear radar system. Although there is no intent to certify the NASA system, the procedures developed may prove useful to manufacturers that plan to undergo the certification process. The certification methodology for forward-looking wind shear detection radars will require estimation of system performance in several FAA-specified microburst/clutter scenarios as well as the estimation of probabilities of missed and false hazard alerts under general operational conditions. Because of the near-impossibility of obtaining these results experimentally, analytical and simulation approaches must be used. Hazard detection algorithms were developed that derived predictive estimates of aircraft hazard from basic radar measurements of weather reflectivity and radial wind velocity. These algorithms were designed to prevent false alarms due to ground clutter while providing accurate predictions of hazard to the aircraft due to weather. A method of calculation of the probability of missed and false hazard alerts has been developed that takes into account the effect of the various algorithms used in the system and provides estimates of the probability of missed and false alerts per microburst encounter under weather conditions found at Denver, Kansas City, and Orlando. Simulation techniques have been developed that permit the proper merging of radar ground clutter data (obtained from flight tests) with simulated microburst data (obtained from microburst models) to estimate system performance using the microburst/clutter scenarios defined by the FAA. Author

N95-13206*# Westinghouse Electric Corp., Baltimore, MD. Electronic Systems Group.
CERTIFICATION OF WINDSHEAR PERFORMANCE WITH RTCA CLASS D RADOMES
BRUCE D. MATHEWS, FRAN MILLER, KIRK RITTENHOUSE, LEE BARNETT, and WILLIAM ROWE *In* NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 489-498 Jul. 1994
Avail: CASI HC A02/MF A04

Superposition testing of detection range performance forms a digital signal for input into a simulation of signal and data processing equipment and algorithms to be employed in a sensor system for advanced warning of hazardous windshear. For suitable pulse-Doppler radar, recording of the digital data at the input to the digital signal processor furnishes a realistic operational scenario and environmentally responsive clutter signal including all sidelobe clutter, ground moving target indications (GMTI), and large signal spurious due to mainbeam clutter and/or RFI respective of the urban airport clutter and aircraft scenarios (approach and landing antenna pointing). For linear radar system processes, a signal at the same point in the process from a hazard phenomena may be calculated from models of the scattering phenomena, for example, as represented in fine 3 dimensional reflectivity and velocity grid structures. Superposition testing furnishes a competing signal environment for detection and warning time performance confirmation of phenomena uncontrollable in a natural environment. Author

N95-13207*# Coherent Technologies, Inc., Boulder, CO.
AIRPORT SURVEILLANCE USING A SOLID STATE COHERENT LIDAR
R. MILTON HUFFAKER and STEPHEN M. HANNON *In* NASA.

Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 499-523 Jul. 1994
Avail: CASI HC A03/MF A04

The utility of solid state coherent LIDAR was assessed in the following application areas: (1) wake vortices; (2) dry and wet microburst windshear; (3) gusts; (4) vertical and general wind profiling; and (5) cloud ceiling. The system performance model described was based on a concept definition, system sizing, measurement planning, and algorithm and graphics display development. Data were collected at the Kennedy Space Center and the National Weather Service site adjacent to Denver's Stapleton Airport. CASI

N95-13208*# Research Triangle Inst., Hampton, VA.
CHARACTERISTICS OF CIVIL AVIATION ATMOSPHERIC HAZARDS
ROBERT E. MARSHALL, J. MONTOYA, MARK A. RICHARDS, and J. GALLIANO *In* NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 545-568 Jul. 1994
Avail: CASI HC A03/MF A04

Clear air turbulence, wake vortices, dry hail, and volcanic ash are hazards to civil aviation that have not been brought to the forefront of public attention by a catastrophic accident. However, these four hazards are responsible for major and minor injuries, emotional trauma, significant aircraft damage, and in route and terminal area inefficiency. Most injuries occur during clear air turbulence. There is significant aircraft damage for any volcanic ash encounter. Rolls induced by wake vortices occur near the ground. Dry hail often appears as an area of weak echo on the weather radar. This paper will present the meteorological, electromagnetic, and spatiotemporal characteristics of each hazard. A description of a typical aircraft encounter with each hazard will be given. Analyzed microwave and millimeter wave sensor systems to detect each hazard will be presented. Author

N95-13209*# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
GROUND-BASED WAKE VORTEX MONITORING, PREDICTION, AND ATC INTERFACE
STEVEN D. CAMPBELL and JAMES E. EVANS *In* NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 569-601 Jul. 1994
(Contract(s)/Grant(s): F19628-90-C-002)
Avail: CASI HC A03/MF A04

This talk will discuss three elements of a proposed Wake Vortex Advisory Service: monitoring, prediction and ATC interface. The monitoring element is needed to ensure safety by warning controllers of hazardous wake vortex conditions. Such conditions exist when wake vortices persist in the approach/departure flight paths due to advection or to atmospheric conditions which prevent their decay. The prediction element is needed to provide ATC supervisors with advance warning that wake vortex separation conditions are about to change (i.e., require increased or decreased wake vortex separation). The ATC interface element is needed to provide controllers with adaptive wake vortex separations. The use of these adaptive wake vortex separations would lead to increased airport capacity under most conditions, while maintaining safety under conditions of wake vortex hazard. Author

N95-13211*# Coherent Technologies, Inc., Boulder, CO.
WAKE VORTEX DETECTION AT DENVER STAPLETON AIRPORT WITH A PULSED 2-MICRON COHERENT LIDAR
STEPHEN M. HANNON and J. ALEX THOMSON *In* NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 625-650 Jul. 1994
Avail: CASI HC A03/MF A04

This report describes the effort undertaken to relate aircraft wake history to the local environment. This involved the monitoring of the embedded windfield, monitoring of local meteorological parameters, a high-resolution velocity field analysis in vertical scan planes and measurement of the axial velocity signature. A flashlight pumped 2.09 micron solid state coherent laser radar system was used to detect and track wake vortices. Strong wake vortex signatures were measured for moderate to large aircraft at Denver's Stapleton airport and a large vortex database was compiled. CASI

N95-13212*# Martin Marietta Corp., Moorestown, NJ. Government Electronic Systems.
DOPPLER RADAR DETECTION OF VORTEX HAZARD INDICATORS
JERALD D. NESPOR, B. HUDSON, R. L. STEGALL, and JEROME E. FREEDMAN *In* NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 651-688 Jul. 1994
Avail: CASI HC A03/MF A04

Wake vortex experiments were conducted at White Sands Missile Range, NM using the AN/MPS-39 Multiple Object Tracking Radar (MOTR). The purpose of these experiments was twofold. The first objective was to verify that radar returns from wake vortex are observed for some time after the passage of an aircraft. The second objective was to verify that other vortex hazard indicators such as ambient wind speed and direction could also be detected. The present study addresses the Doppler characteristics of wake vortex and clear air returns based upon measurements employing MOTR, a very sensitive C-Band phased array radar. In this regard, the experiment was conducted so that the spectral characteristics could be determined on a dwell to-dwell basis. Results are presented from measurements of the backscattered power (equivalent structure constant), radial velocity and spectral width when the aircraft flies transverse and axial to the radar beam. The statistics of the backscattered power and spectral width for each case are given. In addition, the scan strategy, experimental test procedure and radar parameters are presented. Author

N95-13247 National Inst. of Standards and Technology, Gaithersburg, MD. BFRL.
EVALUATION OF ALTERNATIVE IN-FLIGHT FIRE SUPPRESSANTS FOR FULL-SCALE TESTING IN SIMULATED AIRCRAFT ENGINE NACELLES AND DRY BAYS
W. L. GROSSHANDLER, R. G. GANN, and W. M. PITTS Apr. 1994 857 p Sponsored by Dept. of AF; Naval Air Systems Command; Army Aviation and Troop Command; and FAA
(PB94-203403; NIST/SP-861) Avail: Issuing Activity (National Technical Information Service (NTIS))

Civilian and military aircraft suppliers and operators are searching for alternatives to the discontinued chemical Halon 1301 (CF_3Br) for protecting aircraft against in-flight fires. This study identifies the best two or three candidates from among a list of twelve fluorocarbons (FC's), hydrofluorocarbons (HFC's), and hydrochlorofluorocarbons (HCFC's) for full-scale testing in the engine nacelle and dry bay simulators at Wright-Patterson Air Force Base. An assessment of the potential for a powder, sodium bicarbonate ($NaHCO_3$), and other realistic gaseous candidates was also requested. The primary recommendations for the dry bay application were FC-218 and HFC-125; partial testing of CF_3I was also recommended. Details of all aspects of the research program and the rationale for making these recommendations are provided in this special publication. NTIS

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

N95-12230# New South Wales Univ., Kensington (Australia). School of Engineering.
EFFICIENT AND EFFECTIVE HANDLING OF CYCLE SLIPS IN GLOBAL POSITIONING SYSTEM DATA Ph.D. Thesis Abstract Only
CHING-MEI CHU 1994 1 p
Avail: Issuing Activity

A prerequisite for high precision GPS-based geodesy is the reliable detection and correction of cycle slips in the carrier phase data. Without reliable data editing, further processing of GPS data is compromised. The detection and repair of cycle slips can, however, be a labor intensive and time consuming procedure, particularly if the data is noisy, if there are gaps in the data series and there are many slips on more than one satellite at the same time. In this research, the possibility of performing efficient and effective cycle slip editing of GPS carrier phase signal was studied and a polynomial solution technique was developed. The technique was designed to operate in either a single-station mode or multi-station mode, but was used in the single-station model for most investigations. There are a number of advantages in such a procedure, including: (1) it can be used on site, shortly after data has been collected; and (2) it permits cycle slips to be detected and repaired in the raw one-way data, a significant boon if phase data is to be processed in the undifferenced (as opposed to the double-differenced) mode. Today a number of software packages are available to process GPS observations for high precision, scientific applications. They all provide a number of a different options for data processing. Solutions can therefore differ due to a number of factors, such as the algorithms themselves, the frequencies or frequency combinations used, cutoff angle selected, etc. Often there is no standardised procedure, just precedent, the analyst has a variety of data processing strategies from which to choose reasonable, appropriate, and justifiable alternatives, to obtain the "best" solutions. Do different solutions and software agree with each other? And how accurate are the results? We used GAMIT, a well established GPS program, to verify the technique of cycle slip editing. The technique has been shown to be capable of editing cycle slips reliably and quickly. Solutions using two processing methods (GAMIT and our own scientific software) were compared. Comparisons were also made between solutions in which cycle slip detection and repair were carried out within two programs. Significant differences were detected between them using two 'clean' data sets. The impact of undetected cycle slips on a GPS network solution has also been studied in this research. The simulation of cycle slip was done to study the effect of leaving undetected cycle slips. The results confirmed that, for the highest precision, all cycle slips must be removed from the data thoroughly before a solution is carried out.
Author (revised)

N95-12582# Helsinki Univ. of Technology, Espoo (Finland). Automation Technology Lab.
USING LANDMARKS FOR THE VEHICLE LOCATION MEASUREMENT
H. YANG Feb. 1994 23 p
(PB94-184512; ISBN-951-22-1994-8) Avail: CASI HC A03/MF A01

This paper mainly deals with the position of the ground vehicle as well as finding its heading direction by using landmarks. First, from the geometric theorems, a set of reasoning is given in detail for the formulations that were introduced. Some limited conditions are attached to these formulations for calculating without mistakes in some cases. Some formulations are simplified, and some equations were developed for the special cases. Moreover, on the basis of above, a new method for calculating the position of the vehicle is proposed. In this method, instead of three marks, one angle and only two marks are required for the calculations. The advantage of this method is to use one hardware that measures one angle to reduce 1/3 amount of the landmark. The analyses and experiences show that the new method has advantages in the position calculating accuracy requirement as well as the processing speed. In this paper, an algorithm for recognizing the circle-landmarks is also proposed. Then some errors are analyzed, which give some suggestions to fix camera and landmarks.
NTIS

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AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

N95-11699*# Arizona State Univ., Tempe, AZ. Dept. of Mechanical and Aerospace Engineering.
THE POTENTIAL OF GENETIC ALGORITHMS FOR CONCEPTUAL DESIGN OF ROTOR SYSTEMS Semiannual Report
WILLIAM A. CROSSLEY, VALANA L. WELLS, and DAVID H. LAANANEN 1993 29 p
(Contract(s)/Grant(s): NAG2-882)
(NASA-CR-196813; NAS 1.26:196813) Avail: CASI HC A03/MF A01

The capabilities of genetic algorithms as a non-calculus based, global search method make them potentially useful in the conceptual design of rotor systems. Coupling reasonably simple analysis tools to the genetic algorithm was accomplished, and the resulting program was used to generate designs for rotor systems to match requirements similar to those of both an existing helicopter and a proposed helicopter design. This provides a comparison with the existing design and also provides insight into the potential of genetic algorithms in design of new rotors.
Author

N95-11774 ESDU International Ltd., London (England).
SYMMETRIC STEADY MANOEUVRE LOADS ON RIGID AIRCRAFT OF CLASSICAL CONFIGURATION AT SUBSONIC SPEEDS
Apr. 1994 27 p
(ISSN 0141-3988)
(ESDU-94009; ISBN-0-85679-896-7) Avail: ESDU

ESDU 94009 examines the process of determining the structural strength requirements for an aircraft in steady maneuvering flight. To evaluate the shear force, bending moment and torque across the wing span and along the fuselage requires a knowledge of the mass distribution and of the loading distribution of each surface. The loading depends on the maneuver loads appropriate to the use of the aircraft. To provide the loading information, the aircraft is here treated as a wing-fuselage combination with the tail applying a point load acting at the aerodynamic center of the tailplane. The tail assembly is treated as a point mass. The loading on the wing-body combination is considered as wing lift and pitching movement distributions along the span, taking account of camber, twist, incidence and pitch rate, the carry-over lift on the fuselage and the lift distributions on the fuselage and on the engine nacelles. The spanwise distribution of the chordwise position of the wing-alone aerodynamic center is required together with the centers of lift of the carry-over lift and of the nacelle loading. ESDU 94009 develops the equations for these loading distributions in terms of the component contributions for level flight, a steady pitch-up, and a steady turn. It also discusses sources for the aerodynamic data, in particular the use of ESDU data from the Aerodynamics and Transonic Aerodynamics Sub-series.
Author

N95-11793 ESDU International Ltd., London (England).
APPLICATION OF MULTIVARIATE OPTIMISATION TECHNIQUES TO DETERMINATION OF OPTIMUM FLIGHT PATH TRAJECTORIES
May 1994 26 p
(ISSN 0141-4054)
(ESDU-94012; ISBN-0-85679-899-1) Avail: ESDU

ESDU 94012 explains in broad terms the method of optimization used by such techniques and emphasizes that numerical optimization will not locate an absolute minimum but requires the user to set a tolerance on the result, the choice of which is critical. The value of seeking an optimum from two diverse starting points is suggested, and will usually allow any suboptimum located to be eliminated and will enable an assessment to be made of the choice of tolerance. Using results obtained in the work of ESDU 93021 optimizing a complete sortie, the information to be gleaned from exploration around the calculated optimum is illustrated. Also, it is noted that nonoptimum results can be obtained and it is important to assess the trends in the results as an aid to eliminating them, again illustrated with data obtained for ESDU 93021. To use the optimizer, subroutines have to be written, in the case of ESDU 93021 to calculate the segments of the flight profile. Because the optimizer needs gradients to the variables and constraints, the subroutines may have to work in unrealistic areas and any optimal results obtained in such regions must be trapped and discounted. The treatment of finite steps in a variable is considered (in this case cruise height as constrained by air traffic rules). The particular features of the optimizer RQPMIN, developed at the then Royal Aerospace Establishment, are discussed, and the format of its input and output files illustrated. ESDU

N95-11794 ESDU International Ltd., London (England).
EXAMPLES OF FLIGHT PATH OPTIMISATION USING A MULTIVARIATE GRADIENT-SEARCH METHOD. ADDENDUM A: VARIATION OF OPTIMUM FLIGHT PROFILE PARAMETERS WITH RANGE
Jun. 1994 6 p
(ISSN 0141-4054)
(ESDU-94016-ADD-A; ISBN-0-85679-903-3) Avail: ESDU

ESDU 94016 gives a further study to that in ESDU 93021 of optimizing a complete sortie. The aircraft is the same as used in ESDU 93021, and fuel required (and hence ramp mass) is minimized for a series of ranges from 150 to 3900 n. miles under the same constraints and assumptions on fuel reserves as were previously used. The profile parameters to vary are climb and descent speed, cruise Mach number, and height at start of cruise, and a cruise-climb was used because those profile parameters showed greater sensitivity than in the more practical level or stepped cruise and so illustrated the effects better. Sketches show the effect of range on the profile flown; the height at start and end of cruise; the Mach number in climb, cruise, and descent; and the ramp mass. The flight profile parameters vary little for ranges exceeding 1000 n. miles when for each range the profile effectively joins at the top of climb the optimum for 3900 n. mile range; below 1000 n. mile range significant changes occur down to 150 n. mile range to retain a cruise segment starting at progressively lower heights. Below 150 n. mile the profile is a simple climb and descent. ESDU

N95-11952* McDonnell-Douglas Aerospace, Saint Louis, MO.
IMPACT OF AGILITY REQUIREMENTS ON CONFIGURATION SYNTHESIS
PATRICK J. ONEIL, GREGORY NYBERG, ROBIN DETURK, DANIEL W. SEAL, and CHRISTIAN E. GRETHLEIN Hampton, VA NASA Sep. 1994 367 p
(Contract(s)/Grant(s): NAS1-18763; RTOP 505-68-70-09)
(NASA-CR-4627; NAS 1.26:4627) Avail: Issuing Activity

A configuration design study was performed by McDonnell Douglas Aerospace (MDA) for the NASA Langley Research Center to determine the impact of agility-based requirements on the design of multirole aircraft. Design guidelines and methodologies were developed which can guide the aircraft designer in the selection of aerodynamics, controls, avionics, propulsion, and materials technologies for a given level of both agility and observables requirements. A matrix of nine aircraft was generated to investigate the quantitative effects of agility-based requirements and observables requirements on vehicle design and sizing. This matrix of aircraft indicates the relatively large TOGW penalty associated with high levels of agility when applied to a vehicle with significant observables requirements. However, the matrix also suggests that optimal integration of certain advanced technologies, such as in tailless fighter design synthesis, might have significant advantages over designs incorporating more conventional technologies. Finally, the study identifies the types of technologies required to achieve high agility under different observables requirements and allows some assessment of the current risks associated with these technologies and how future research might be focused toward reducing such risks. Author

N95-12225*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
FLIGHT INVESTIGATION OF THE USE OF A NOSE GEAR JUMP STRUT TO REDUCE TAKEOFF GROUND ROLL DISTANCE OF STOL AIRCRAFT
JOSEPH C. EPPEL, GORDON HARDY, and JAMES L. MARTIN
Sep. 1994 44 p
(Contract(s)/Grant(s): RTOP 505-59-37)
(NASA-TM-108819; A-94076; NAS 1.15:108819) Avail: CASI HC A03/MF A01

A series of flight tests was conducted to evaluate the reduction of takeoff ground roll distance obtainable from a rapid extension of the nose gear strut. The NASA Quiet Short-haul Research Aircraft (QSRA) used for this investigation is a transport-size short takeoff and landing (STOL) research vehicle with a slightly swept wing that employs the upper surface blowing (USB) concept to attain the high lift levels required for its low speed, short-field performance. Minor modifications to the conventional nose gear assembly and the addition of a high pressure pneumatic system and a control system provided the extendible nose gear, or 'jump strut,' capability. The limited flight test program explored the effects of thrust-to-weight ratio, storage tank initial pressure, and control valve open time duration on the ground roll distance. The data show that the predicted reduction of takeoff ground roll on the order of 10 percent was achieved with the use of the jump strut. Takeoff performance with the jump strut was also found to be essentially independent of the pneumatic supply pressure and was only slightly affected by control valve open time within the range of the parameters examined. Author (revised)

N95-12294*# Michigan Univ., Ann Arbor, MI. Dept. of Aerospace Engineering.
CONCEPTUAL DESIGN OF THE AE481 DEMON REMOTELY PILOTED VEHICLE (RPV)
CHRIS HAILES, JILL KOLVER, JULIE NESTOR, MIKE PATTERSON, JAN SELOW, PRADIP SAGDEO, and KENNETH KATZ 1994 44 p
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197164; NAS 1.26:197164) Avail: CASI HC A03/MF A01

This project report presents a conceptual design for a high speed remotely piloted vehicle (RPV). The AE481 Demon RPV is capable of performing video reconnaissance missions and electronic jamming over hostile territory. The RPV cruises at a speed of Mach 0.8 and an altitude of 300 feet above the ground throughout its mission. It incorporates a rocket assisted takeoff and a parachute-airbag landing. Missions are preprogrammed, but in-flight changes are possible. The Demon is the answer to a military need for a high speed, low altitude RPV. The design methods, onboard systems, and avionics payload are discussed in this conceptual design report along with economic viability. Author

N95-12305*# Embry-Riddle Aeronautical Univ., Daytona Beach, FL.

VIPER CABIN-FUSELAGE STRUCTURAL DESIGN CONCEPT WITH ENGINE INSTALLATION AND WING STRUCTURAL DESIGN

B. MARCHESSEAULT, D. CARR, T. MCCORKLE, C. STEVENS, and D. TURNER 6 Dec. 1993 77 p
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197162; NAS 1.26:197162) Avail: CASI HC A05/MF A01

This report describes the process and considerations in designing the cabin, nose, drive shaft, and wing assemblies for the 'Viper' concept aircraft. Interfaces of these assemblies, as well as interfaces with the sections of the aircraft aft of the cabin, are also discussed. The results of the design process are included. The goal of this project is to provide a structural design which complies with FAR 23 requirements regarding occupant safety, emergency landing loads, and maneuvering loads. The design must also address the interfaces of the various systems in the cabin, nose, and wing, including the drive shaft, venting, vacuum, electrical, fuel, and control systems. Interfaces between the cabin assembly and the wing carrythrough and empennage assemblies were required, as well. In the design of the wing assemblies, consistency with the existing cabin design was required. The major areas considered in this report are materials and construction, loading, maintenance, environmental considerations, wing assembly fatigue, and weight. The first three areas are developed separately for the nose, cabin, drive shaft, and wing assemblies, while the last three are discussed for the entire design. For each assembly, loading calculations were performed to determine the proper sizing of major load carrying components. Table 1.0 lists the resulting margins of safety for these key components, along with the types of the loads involved, and the page number upon which they are discussed. Author (revised)

N95-12363*# Purdue Univ., West Lafayette, IN. School of Aeronautics and Astronautics.

DESIGN OF A HIGH CAPACITY LONG RANGE CARGO AIRCRAFT Final Report

TERRENCE A. WEISSHAAR 30 Jul. 1994 10 p
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197176; NAS 1.26:197176) Avail: CASI HC A02/MF A01

This report examines the design of a long range cargo transport to attempt to reduce ton-mile shipping costs and to stimulate the air cargo market. This design effort involves the usual issues but must also include consideration of: airport terminal facilities; cargo loading and unloading; and defeating the 'square-cube' law to design large structures. This report reviews the long range transport design problem and several solutions developed by senior student design teams at Purdue University. The results show that it will be difficult to build large transports unless the infrastructure is changed and unless the basic form of the airplane changes so that aerodynamic and structural efficiencies are employed. Author

N95-12410 Naval Postgraduate School, Monterey, CA.

FLIGHT DYNAMICS OF AN UNMANNED AERIAL VEHICLE M.S. Thesis

ERIC J. WATKISS Mar. 1994 94 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A282259) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Moments of inertia were experimentally determined and longitudinal and lateral/directional static and dynamic stability and control derivatives were estimated for a fixed wing Unmanned Air Vehicle (UAV). Dynamic responses to various inputs were predicted based upon the estimated derivatives. A divergent spiral mode was revealed, but no particularly hazardous dynamics were predicted. The aircraft was then instrumented with an airspeed indicator, which when combined with the ability to determine elevator deflection through trim setting on the flight control transmitter, allowed for the determination of the aircraft's neutral point through flight test. The neutral point determined experimentally corresponded well to the theoretical neutral point. However, further flight testing with improved instrumentation is planned to raise the confidence level in the neutral point location. Further flight testing will also include dynamic studies in order to refine the estimated stability and control derivatives. DTIC

N95-12530*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.

THE ELITE: A HIGH SPEED, LOW-COST GENERAL AVIATION AIRCRAFT FOR AEROWORLD Final Design Proposal

AMY RUETER, JONATHAN FAY, DOUGLAS STAUDMEISTER, DANIEL AVIS, TUAN LE, and STEVEN STEM Apr. 1994 144 p Prepared for Universities Space Research Association, Columbia, MD
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197161; NAS 1.26:197161) Avail: CASI HC A07/MF A02

The Elite is a six passenger, general aviation aircraft targeted at the upper middle class private pilot. The Elite is a low wing, conventional monoplane utilizing rudder, ailerons, and a stabilator. The Elite will create a new class of aircraft in Aeroworld. This class of aircraft will demonstrate a substantial improvement in cruise speed over the current existing commercial fleet of aircraft in Aeroworld. This new class will be capable of servicing all existing airstrips in Aeroworld, including rough and short airways. The drivers of this design were aesthetics, a high cruise speed, and take-off distance. Author (revised)

N95-12609*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.

ICARUS REWAXED: A HIGH SPEED, LOW-COST GENERAL AVIATION AIRCRAFT FOR AEROWORLD

BRYAN FARRENS, MACY HUECKEL, DAN FULKERSON, MATT BARENTS, BRIAN CAPOZZI, and KERI RAMSEY Apr. 1994 159 p Prepared for Universities Space Research Association, Columbia, MD
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197155; NAS 1.26:197155) Avail: CASI HC A08/MF A02

Icarus Rewaxed is a single engine, six passenger, general aviation airplane. With a cruise velocity of 72 ft/s, the Icarus can compete with the performance of any other airplane in its class with an eye on economics and safety. It has a very competitive initial price ($3498.00) and cost per flight ($6.36-8.40). Icarus can serve all airports in Aeroworld with a takeoff distance of 25.4 feet and maximum range of 38,000 feet. It is capable of taking off from an unprepared field with a grass depth of 3 inches. Icarus Rewaxed fills the market need for a high-speed, low cost aircraft. It provides customers with a general aviation craft that can compete in the existing performance market with the added security of an advanced structure. With the use of advanced materials, the maneuvering capability of the Icarus is increased, as it can withstand greater load factors than previous aircraft. Author (revised)

N95-12626*# Kansas Univ., Lawrence, KS. Graduate Design Class.

GEMINI: A LONG-RANGE CARGO TRANSPORT

10 May 1994 151 p Prepared for Universities Space Research Association, Houston, TX
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197149; NAS 1.26:197149) Avail: CASI HC A08/MF A02

The proposed Gemini, a long-range cargo transport, is designed as a high capacity, dedicated cargo transporter of 8'x8'x20' inter-modal containers, and long-range design. These requirements will result in a design that is larger than any existing aircraft. Due to the size, a conventional configuration would result in an aircraft unable to operate economically at existing airports. It is necessary to design for a minimum possible empty weight, wingspan, and landing gear track. After considering both a single fuselage biplane and a double fuselage biplane configuration, the design team choose the double biplane configuration. Both of these configuration choices result in a reduced wing root bending moment and subsequently in substantial savings in the wing weight. An overall decrease in the weight of the airplane, its systems, and fuel will be a direct result of the wing weight savings. Author (revised)

N95-12628*# California Polytechnic State Univ., San Luis Obispo, CA.
THE FC-1D: THE PROFITABLE ALTERNATIVE FLYING CIRCUS COMMERCIAL AVIATION GROUP
VICTOR J. MEZA, JAIME ALVAREZ, BROOK HARRINGTON, MICHAEL A. LUJAN, DAVID MITLYNG, ANDY SAROUGHIAN, ALEX SILVA, and TIM TEALE 6 Jun. 1994 110 p Prepared for Universities Space Research Association, Columbia, MD
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197152; NAS 1.26:197152) Avail: CASI HC A06/MF A02

The FC-1D was designed as an advanced solution for a low cost commercial transport meeting or exceeding all of the 1993/1994 AIAA/Lockheed request for proposal requirements. The driving philosophy behind the design of the FC-1D was the reduction of airline direct operating costs. Every effort was made during the design process to have the customer in mind. The Flying Circus Commercial Aviation Group targeted reductions in drag, fuel consumption, manufacturing costs, and maintenance costs. Flying Circus emphasized cost reduction throughout the entire design program. Drag reduction was achieved by implementation of the aft nacelle wing configuration to reduce cruise drag and increase cruise speeds. To reduce induced drag, rather than increasing the wing span of the FC-1D, spiroids were included in the efficient wing design. Profile and friction drag are reduced by using riblets in place of paint around the fuselage and empennage of the FC-1D. Choosing a single aisle configuration enabled the Flying Circus to optimize the fuselage diameter. Thus, reducing fuselage drag while gaining high structural efficiency. To further reduce fuel consumption a weight reduction program was conducted through the use of composite materials. An additional quality of the FC-1D is its design for low cost manufacturing and assembly. As a result of this design attribute, the FC-1D will have fewer parts which reduces weight as well as maintenance and assembly costs. The FC-1D is affordable and effective, the apex of commercial transport design.
Author (revised)

N95-12636*# Embry-Riddle Aeronautical Univ., Daytona Beach, FL.
TRITON 2 (1B)
MICHELLE L. CLARK, A. G. MEISS, JASON R. NEHER, and RICHARD H. RUDOLPH 3 May 1994 94 p Prepared for Universities Space Research Association, Columbia, MD
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197188; NAS 1.26:197188) Avail: CASI HC A05/MF A01

The goal of this project was to perform a detailed design analysis on a conceptually designed preliminary flight trainer. The Triton 2 (1B) must meet the current regulations in FAR Part 23. The detailed design process included the tasks of sizing load carrying members, pulleys, bolts, rivets, and fuselage skin for the safety cage, empennage, and control systems. In addition to the regulations in FAR Part 23, the detail design had to meet established minimums for environmental operating conditions and material corrosion resistance. Derived from text

N95-12637*# California Polytechnic State Univ., San Luis Obispo, CA.
THE OFP-6M TRANSPORT JET
KELLY ALEXANDER, BRIAN HENEGHAN, JOULES HOLMES, BRET HUGHES, MARK KETTERING, JENNIFER WELLS, and TODD WHELAN 3 Jun. 1994 120 p Prepared for Universities Space Research Association, Columbia, MD Original contains color illustrations
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197159; NAS 1.26:197159) Avail: CASI HC A06/MF A02; 1 functional color page

This report presents a preliminary design of a commercial jet transport that meets the criteria of the Request For Proposal presented by the American Institute of Aeronautics and Astronauts (AIAA). The proposal requires an innovative design of a low cost domestic commercial transport that will reduce operating costs for airline companies while still meeting present and future requirements of the Federal Aviation Regulations for this type of aircraft. Specifications for the design include a mixed class, 153 passenger aircraft, traveling a range of 3000 nm. The intent of the project is to identify factors that reduce cost and to design within the limits of these constraints. The project includes techniques or options that incorporate new technologies but do not override practicality, alternative design approaches, and a comparison between the new design and current aircraft in its class. The OFP-6M is an alternative design approach to the conventional commercial transport jet and is geared towards customer satisfaction through efficiency and reliability. The goals of the OFP-6M transport design are to provide original, sensible, and practical solutions by combining essential preliminary design factors with growing technology. The design focus of the OFP-6M reduces costs by simplifying systems where significant weight or maintenance savings can be achieved, and by integrating advanced technology for improved performance. Key aspects of the OFP-6M design are efficient use of materials like composites, and efficient advanced ducted high bypass turbofan engines. The high bypass engines lower fuel consumption and aid in reducing costs and meeting future noise emission restrictions. Composites are used for most structural components, including flooring and wing box. Although composites are an emerging technology and presently, a high maintenance material, they can be cost effective and an alternative to aluminum structures when correct manufacturing and design strategies are applied. Since, composites are lighter and require less manufacturing of complex parts, they can significantly reduce structural weight. Because of the large 17 ft. diameter, sophisticated aerodynamic considerations were implemented to significantly lower the drag. Supercritical airfoils were chosen with simple control surface design which allows for less maintenance and manufacturing costs. The interior configuration accommodates either all passenger, dual and single class flights or complete cargo. Also, a relaxed conventional stability is integrated with a stability augmentation system. As a result of these design implementations, the OFP-6M bottom line direct operating costs, compare favorably with the Boeing 737 and 757, at 3.49 cents per available seat mile and costs are expected to reduce when improved manufacturing and maintenance methods are implemented.
Author (revised)

N95-12638*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
THE BALSA BULLET: A HIGH SPEED, LOW-COST GENERAL AVIATION AIRCRAFT FOR AEROWORLD Final Design Proposal
KEVIN EASTLAND, SEAN GREENWOOD, DAN KELLY, CHUCK LEONARD, JOHN ROOFF, and JEFF SCHEROCK Apr. 1994 172 p Prepared for Universities Space Research Association, Columbia, MD
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197165; NAS 1.26:197165) Avail: CASI HC A08/MF A02

The Balsa Bullet is a high speed, low cost six passenger general aviation aircraft. It will cruise at a speed of 55 ft/s with a maximum speed of 75 ft/s for distances in excess of 27000 feet. This range and speed combination provide The Balsa Bullet with the capability to service any two existing airports in Aeroworld in an efficient and timely manner. Overall, three major design drivers have been identified by the design team. The first is to provide a low cost airplane to the Aeroworld market. Maintaining the low cost objective will not simply meet the mission objective, but will also make the

Bullet an economically viable option for a wide number of consumers. The Balsa Bullet has a total manufacturing cost of $1000 with a price to the consumer of only $2562. The second major driver is high speed performance. Once again this driver exists not only to meet the mission objective given Long Shot Aeronautics but it provides a desirable feature to the consumer, pride in owning the fastest aircraft in Aeroworld. The third design driver identified is the capability to service any runway in Aeroworld necessitating the ability to takeoff within 28 ft, the length of the shortest runways in Aeroworld. These design drivers provide three great reasons for the general public to purchase a Bullet. Derived from text

N95-12639*# Embry-Riddle Aeronautical Univ., Daytona Beach, FL. Dept. of Aerospace Engineering.

CABIN FUSELAGE STRUCTURAL DESIGN WITH ENGINE INSTALLATION AND CONTROL SYSTEM

TANAPAAL BALAKRISHNAN, MIKE BISHOP, ILKER GUMUS, JOEL GUSSY, and MIKE TRIGGS 3 May 1994 71 p Prepared for Universities Space Research Association, Columbia, MD

(Contract(s)/Grant(s): NASW-4435)

(NASA-CR-197173; NAS 1.26:197173) Avail: CASI HC A04/MF A01

Design requirements for the cabin, cabin system, flight controls, engine installation, and wing-fuselage interface that provide adequate interior volume for occupant seating, cabin ingress and egress, and safety are presented. The fuselage structure must be sufficient to meet the loadings specified in the appropriate sections of Federal Aviation Regulation Part 23. The critical structure must provide a safe life of 10(exp 6) load cycles and 10,000 operational mission cycles. The cabin seating and controls must provide adjustment to account for various pilot physiques and to aid in maintenance and operation of the aircraft. Seats and doors shall not bind or lockup under normal operation. Cabin systems such as heating and ventilation, electrical, lighting, intercom, and avionics must be included in the design. The control system will consist of ailerons, elevator, and rudders. The system must provide required deflections with a combination of push rods, bell cranks, pulleys, and linkages. The system will be free from slack and provide smooth operation without binding. Environmental considerations include variations in temperature and atmospheric pressure, protection against sand, dust, rain, humidity, ice, snow, salt/fog atmosphere, wind and gusts, and shock and vibration. The following design goals were set to meet the requirements of the statement of work: safety, performance, manufacturing and cost. To prevent the engine from penetrating the passenger area in the event of a crash was the primary safety concern. Weight and the fuselage aerodynamics were the primary performance concerns. Commonality and ease of manufacturing were major considerations to reduce cost. Derived from text

N95-12643*# California Polytechnic State Univ., San Luis Obispo, CA.

CENTRAL COAST DESIGNS: THE EIGHTBALL EXPRESS. TAKING OFF WITH CONVENTION, CRUISING WITH IMPROVEMENTS AND LANDING WITH ABSOLUTE SUCCESS

RYAN EDWIN DAVIS, ANNE MARIE DAWSON, PAUL HANS FECHT, ROMAN ZYABASH FRY, ROBERT VANTRIET, DOMINIQUE DUJALE MACABANTAD, ROBERT GLENN MILLER, GUSTAVO PEREZ, JR., and TIMOTHY MICHAEL WEISE 1 Jun. 1994 109 p Prepared for Universities Space Research Association, Columbia, MD Original contains color illustrations

(Contract(s)/Grant(s): NASW-4435)

(NASA-CR-197181; NAS 1.26:197181) Avail: CASI HC A06/MF A02; 9 functional color pages

The airline industry is very competitive, resulting in most U.S. and many international airlines being unprofitable. Because of this competition the airlines have been engaging in fare wars (which reduce revenue generated by transporting passengers) while inflation has increased. This situation of course is not developing revenue for the airlines. To revive the airlines to profitability, the difference between revenue received and airline operational cost must be improved. To solve these extreme conditions, the Eightball Express was designed with the main philosophy of developing an aircraft with a low direct operating cost and acquisition cost. Central Coast Designs' (CCD) aircraft utilizes primarily aluminum in the structure to minimize manufacturing cost, supercritical airfoil sections to minimize drag, and fuel efficient engines to minimize fuel burn. Furthermore, the aircraft was designed using Total Quality Management and Integrated Product Development to minimize development and manufacturing costs. Using these primary cost reduction techniques, the Eightball Express was designed to meet the Lockheed/AIAA Request for Proposal (RFP) requirements of a low cost, 153 passenger, 3000 nm. range transport. The Eightball Express is able to takeoff on less than a 7000 ft. runway, cruise at Mach 0.82 at an altitude of 36,000 ft. for a range of 3,000 nm., and lands on a 5,000 ft. runway. It is able to perform this mission at a direct operating cost of 3.51 cents/available seat mile in 1992 dollars while the acquisition cost is only $28 million in 1992 dollars. By utilizing and improving on proven technologies, CCD has producedan efficient low cost commercial transport for the future. Author (revised)

N95-12645*# Universities Space Research Association, Columbia, MD.

LCX: PROPOSAL FOR A LOW-COST COMMERCIAL TRANSPORT

TROY HARTMAN, MAZIAR HAYATDAVOUDI, JOEL HETTINGA, MATT HOOPER, and PHONG NGUYEN 1994 102 p Original contains color illustrations

(Contract(s)/Grant(s): NASW-4435)

(NASA-CR-197186; NAS 1.26:197186) Avail: CASI HC A06/MF A02; 8 functional color pages

The LCX has been developed in response to a request for proposal for an aircraft with 153 passenger capacity and a range of 3000 nautical miles. The goals of the LCX are to provide an aircraft which will achieve the stated mission requirements at the lowest cost possible, both for the manufacturer and the operator. Low cost in this request is defined as short and long term profitability. To achieve this objective, modern technologies attributing to low-cost operation without greatly increasing the cost of manufacturing were employed. These technologies include hybrid laminar flow control and the use of developing new manufacturing processes and philosophies. The LCX will provide a competitive alternative to the use of the Airbus A319/320/321 and the Boeing 737 series of aircraft. The LCX has a maximum weight of 150,000 lb. carried by a wing of 1140 ft(exp 2) and an aspect ratio of 10. The selling price of the LCX is 31 million in 1994 US dollars. Author

N95-12689*# Kansas Univ., Lawrence, KS.

A PRELIMINARY DESIGN PROPOSAL FOR A MARITIME PATROL STRIKE AIRCRAFT: MPS-2000 CONDOR

1994 93 p Prepared for Universities Space Research Association, Columbia, MD

(Contract(s)/Grant(s): NASW-4435)

(NASA-CR-197182; NAS 1.26:197182) Avail: CASI HC A05/MF A01

The four member graduate design team assembled to submit a proposal for the 1993/1994 RFP at the University of Kansas has designed a four seat, variable swept wing, twin turbofan aircraft with STOL capabilities. The aircraft is named the MPS-2000 Condor and is capable of carrying air-to-surface or air-to-air weapon systems along with attack and surveillance radar and IRF systems. The aircraft has a cruise range of 800 nautical miles, a loiter of 4 hours, and a dash speed of 500 kts. Derived from text

N95-12695*# Worcester Polytechnic Inst., MA.

DESIGN AND CONSTRUCTION OF A REMOTE PILOTED FLYING WING B.S. Thesis

ALFRED J. COSTA, FRITZ KOOPMAN, CRAIG SOBOLESKI, THAIBA TRIEU, JAIME DUQUETTE, SCOTT KRAUSE, DAVID SUSKO, and THUYBA TRIEU 2 May 1994 187 p Prepared for Universities Space Research Association, Columbia, MD

(Contract(s)/Grant(s): NASW-4435)

(NASA-CR-197195; NAS 1.26:197195) Avail: CASI HC A09/

MF A02

Currently, there is a need for a high-speed, high-lift civilian transport. Although unconventional, a flying wing could fly at speeds in excess of Mach 2 and still retain the capacity of a 747. The design of the flying wing is inherently unstable since it lacks a fuselage and a horizontal tail. The project goal was to design, construct, fly, and test a remote-piloted scale model flying wing. The project was completed as part of the NASA/USRA Advanced Aeronautics Design Program. These unique restrictions required us to implement several fundamental design changes from last year's Elang configuration including wing sweepback and wingtip endplates. Unique features such as a single ducted fan engine, composite structural materials, and an electrostatic stability system were incorporated. The result is the Banshee '94. Our efforts will aid future projects in design and construction techniques so that a viable flying wing can become an integral part of the aviation industry. Author

N95-12700*# Georgia Inst. of Tech., Atlanta, GA. School of Aerospace Engineering.
INTEGRATED DESIGN AND MANUFACTURING FOR THE HIGH SPEED CIVIL TRANSPORT Final Report
JAE MOON LEE, ANURAG GUPTA, CRAIG MUELLER, MONICA MORRISETTE, JOHN DEC, JASON BREWER, KEVIN DONOFRIO, HILTON STURISKY, DOUG SMICK, MENG LIN AN et al. Jun. 1994 99 p Prepared for Universities Space Research Association, Columbia, MD Original contains color illustrations
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197183; NAS 1.26:197183) Avail: CASI HC A05/MF A02; 1 functional color page

In June 1992, the School of Aerospace Engineering at Georgia Tech was awarded a three year NASA University Space Research Association (USRA) Advanced Design Program (ADP) grant to address issues associated with the Integrated Design and Manufacturing of High Speed Civil Transport (HSCT) configurations in its graduate Aerospace Systems Design courses. This report provides an overview of the on-going Georgia Tech initiative to address these design/manufacturing issues during the preliminary design phases of an HSCT concept. The new design methodology presented here has been incorporated in the graduate aerospace design curriculum and is based on the concept of Integrated Product and Process Development (IPPD). The selection of the HSCT as a pilot project was motivated by its potential global transportation payoffs; its technological, environmental, and economic challenges; and its impact on U.S. global competitiveness. This pilot project was the focus of each of the five design courses that form the graduate level aerospace systems design curriculum. This year's main objective was the development of a systematic approach to preliminary design and optimization and its implementation to an HSCT wing/propulsion configuration. The new methodology, based on the Taguchi Parameter Design Optimization Method (PDOM), was established and was used to carry out a parametric study where various feasible alternative configurations were evaluated. The comparison criterion selected for this evaluation was the economic impact of this aircraft, measured in terms of average yield per revenue passenger mile ($/RPM). Author

N95-12702*# Virginia Polytechnic Inst. and State Univ., Blacksburg, VA. Dept. of Aerospace and Ocean Engineering.
DESIGN OF A VEHICLE BASED SYSTEM TO PREVENT OZONE LOSS Final Report
MATTHEW D. TALBOT, STEVEN C. EBY, GLEN J. IRELAND, MICHAEL C. MCWITHEY, MARK S. SCHNEIDER, DANIEL L. YOUNGBLOOD, MATT JOHNSON, and CHRIS TAYLOR 1 Jun. 1994 124 p Prepared for Universities Space Research Association, Columbia, MD
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197199; NAS 1.26:197199) Avail: CASI HC A06/MF A02

This project is designed to be completed over a three year period. Overall project goals are: (1) to understand the processes that contribute to stratospheric ozone loss; (2) to determine the best scheme to prevent ozone loss; and (3) to design a vehicle based system to carry out the prevention scheme. The 1993/1994 design objectives included: (1) to review the results of the 1992/1993 design team, including a reevaluation of the key assumptions used; (2) to develop a matrix of baseline vehicle concepts as candidates for the delivery vehicle; and (3) to develop a selection criteria and perform quantitative trade studies to use in the selection of the specific vehicle concept. Derived from text

N95-12785*# MCAT Inst., San Jose, CA.
DESIGN AND TESTING OF AN OBLIQUE ALL-WING SUPERSONIC TRANSPORT Annual Report
CHRISTOPHER A. LEE Jul. 1994 5 p
(Contract(s)/Grant(s): NCC2-617)
(NASA-CR-196394; NAS 1.26:196394; MCAT-94-09) Avail: CASI HC A01/MF A01

This report describes the preliminary design of an Oblique All-Wing (OAW) supersonic transport and a corresponding wind-tunnel model that was tested in the NASA Ames 9- by 7-Foot supersonic wind tunnel. The main goal was the determination of the cruise performance (lift/drag ratio) of a realistically configured OAW. To achieve an acceptable level of realism, it was necessary to consider many issues of design practicality such as the need for a viable propulsion system, adequate control surfaces, landing gear, provisions for 450 passengers, and fuel to fly 5,000 nautical miles. The aircraft had to be stable, structurally sound, and needed to fit into airports across the world. Support was directed primarily towards integration of the propulsion system, however, there were notable contributions to many aspects of the configuration design, wind tunnel model, and wind tunnel test. Derived from text

N95-12787*# Ohio Aerospace Inst., Brook Park.
OPTIMIZATION OF AEROSPACE STRUCTURES Final Technical Report, 17 Aug. 1990 - 30 Apr. 1993
THEO G. KEITH, JR. and SURYA N. PATNAIK Aug. 1994 7 p
(Contract(s)/Grant(s): NAG3-1203)
(NASA-CR-196763; NAS 1.26:196763) Avail: CASI HC A02/MF A01

Research carried out is grouped under two topics: (1) Design Optimization, and (2) Integrated Force Method of Analysis. Design Optimization Research Topics are singularity alleviation enhances structural optimization methods, computer based design capability extended through substructure synthesis, and optimality criteria provides optimum design for a select class of structural problems. Integrated Force Method of Analysis Research Topics are boundary compatibility formulation improves stress analysis of shell structures. Brief descriptions of the four topics are appended. Author

N95-12831*# Planning Research Corp., Edwards, CA.
STRAIN GAGE SELECTION IN LOADS EQUATIONS USING A GENETIC ALGORITHM
Washington NASA Oct. 1994 21 p
(Contract(s)/Grant(s): NAS2-13445)
(NASA-CR-4597; H-1962; NAS 1.26:4597) Avail: CASI HC A03/MF A01

Traditionally, structural loads are measured using strain gages. A loads calibration test must be done before loads can be accurately measured. In one measurement method, a series of point loads is applied to the structure, and loads equations are derived via the least squares curve fitting algorithm using the strain gage responses to the applied point loads. However, many research structures are highly instrumented with strain gages, and the number and selection of gages used in a loads equation can be problematic. This paper presents an improved technique using a genetic algorithm to choose the strain gages used in the loads equations. Also presented are a comparison of the genetic algorithm performance with the current T-value technique and a variant known as the Best Step-down technique. Examples are shown using aerospace vehicle wings of high and low aspect ratio. In addition, a significant limitation in the current methods is revealed. The genetic algorithm arrived at a comparable

or superior set of gages with significantly less human effort, and could be applied in instances when the current methods could not.
Author

N95-12993*# Universities Space Research Association, Columbia, MD.
CABIN-FUSELAGE-WING STRUCTURAL DESIGN CONCEPT WITH ENGINE INSTALLATION
SCOTT ARIOTTI, M. GARNER, A. CEPEDA, J. VIEIRA, and D. BOLTON 6 Dec. 1993 87 p
(Contract(s)/Grant(s): NASW-4435)
(NASA-CR-197172; NAS 1.26:197172) Avail: CASI HC A05/MF A01

The purpose of this project is to provide a fuselage structural assembly and wing structural design that will be able to withstand the given operational parameters and loads provided by Federal Aviation Regulation Part 23 (FAR 23) and the Statement of Work (SOW). The goal is to provide a durable lightweight structure that will transfer the applied loads through the most efficient load path. Areas of producibility and maintainability of the structure will also be addressed. All of the structural members will also meet or exceed the desired loading criteria, along with providing adequate stiffness, reliability, and fatigue life as stated in the SOW. Considerations need to be made for control system routing and cabin heating/ventilation. The goal of the wing structure and carry through structure is also to provide a simple, lightweight structure that will transfer the aerodynamic forces produced by the wing, tailboom, and landing gear. These forces will be channeled through various internal structures sized for the pre-determined loading criteria. Other considerations were to include space for flaps, ailerons, fuel tanks, and electrical and control system routing. The difficulties encountered in the fuselage design include expanding the fuselage cabin to accept a third occupant in a staggered configuration and providing ample volume for their safety. By adding a third person the CG of aircraft will move forward so the engine needs to be moved aft to compensate for the difference in the moment. This required the provisions of a ring frame structure for the new position of the engine mount. The difficulties encountered in the wing structural design include resizing the wing for the increased capacity and weight, and compensating for a large torsion produced by the tail boom by placing a great number of stiffeners inside the boom, which will result in the relocation of the fuel tank. Finally, an adequate carry through structure for the wing and fuselage interface will be designed to effectively transmit loads through the fuselage. Derived from text

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AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

N95-11913*# Lockheed Engineering and Sciences Co., Houston, TX.
AN AVIONICS SCENARIO AND COMMAND MODEL DESCRIPTION FOR SPACE GENERIC OPEN AVIONICS ARCHITECTURE (SGOAA)
JOHN R. STOVALL and RICHARD B. WRAY Houston, TX NASA Jul. 1994 203 p
(Contract(s)/Grant(s): NAS9-19100)
(NASA-CR-188330; NAS 1.26:188330; LESC-31195) Avail: CASI HC A10/MF A03

This paper presents a description of a model for a space vehicle operational scenario and the commands for avionics. This model will be used in developing a dynamic architecture simulation model using the Statemate CASE tool for validation of the Space Generic Open Avionics Architecture (SGOAA). The SGOAA has been proposed as an avionics architecture standard to NASA through its Strategic Avionics Technology Working Group (SATWG) and has been accepted by the Society of Automotive Engineers (SAE) for conversion into an SAE Avionics Standard. This architecture was developed for the Flight Data Systems Division (FDSD) of the NASA Johnson Space Center (JSC) by the Lockheed Engineering and Sciences Company (LESC), Houston, Texas. This SGOAA includes a generic system architecture for the entities in spacecraft avionics, a generic processing external and internal hardware architecture, and a nine class model of interfaces. The SGOAA is both scalable and recursive and can be applied to any hierarchical level of hardware/software processing systems. Derived from text

N95-12591# Wright Lab., Wright-Patterson AFB, OH.
DRAFT STANDARD FOR COLOR ACTIVE MATRIX LIQUID CRYSTAL DISPLAYS (AMLCDS) IN US MILITARY AIRCRAFT. RECOMMENDED BEST PRACTICES Final Report, 1 Apr. 1993 - 1 Jun. 1994
DARREL G. HOPPER, WILLIAM K. DOLEZAL, KEITH SCHUR, and JOHN W. LICCIONE Jun. 1994 70 p
(Contract(s)/Grant(s): AF PROJ. 2003)
(AD-A282950; WL-TR-93-1177) Avail: CASI HC A04/MF A01

This report is written in the format of a military standard as a draft to establish the performance, form, fit, design, and development requirements for a family of color active matrix liquid crystal display (AMLCD) modules to be procured for military airborne cockpit applications. This document provides guidance for the selection, design, and development of AMLCD flat panel displays for use in military aircraft cockpits. Author (DTIC)

N95-13027*# Smith Advanced Technology, Inc., Huntsville, AL.
HLLV AVIONICS REQUIREMENTS STUDY AND ELECTRONIC FILING SYSTEM DATABASE DEVELOPMENT Final Report
30 Jun. 1994 22 p
(Contract(s)/Grant(s): NAS8-39215)
(NASA-CR-193993; NAS 1.26:193993) Avail: CASI HC A03/MF A01

This final report provides a summary of achievements and activities performed under Contract NAS8-39215. The contract's objective was to explore a new way of delivering, storing, accessing, and archiving study products and information and to define top level system requirements for Heavy Lift Launch Vehicle (HLLV) avionics that incorporate Vehicle Health Management (VHM). This report includes technical objectives, methods, assumptions, recommendations, sample data, and issues as specified by DPD No. 772, DR-3. The report is organized into two major subsections, one specific to each of the two tasks defined in the Statement of Work: the Index Database Task and the HLLV Avionics Requirements Task. The Index Database Task resulted in the selection and modification of a commercial database software tool to contain the data developed during the HLLV Avionics Requirements Task. All summary information is addressed within each task's section. Author (revised)

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AIRCRAFT PROPULSION AND POWER

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

N95-11864*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OBJECT-ORIENTED TECHNOLOGY FOR COMPRESSOR SIMULATION
C. K. DRUMMOND, G. J. FOLLEN, and M. R. CANNON Aug. 1994 23 p Presented at the 30th Joint Propulsion Conference, Indianapolis, IN, 27-29 Jun. 1994; sponsored by AIAA, ASME, SAE, and ASEE
(Contract(s)/Grant(s): RTOP 505-68-32)
(NASA-TM-106723; E-9089; NAS 1.15:106723; AIAA PAPER 94-3095) Avail: CASI HC A03/MF A01

An object-oriented basis for interdisciplinary compressor simulation can, in principle, overcome several barriers associated with the traditional structured (procedural) development approach. This paper presents the results of a research effort with the objective to explore the repercussions on design, analysis, and implementation of a compressor model in an object oriented (OO) language, and to examine the ability of the OO system design to accommodate computational fluid dynamics (CFD) code for compressor performance prediction. Three fundamental results are that: (1) the selection of the object oriented language is not the central issue; enhanced (interdisciplinary) analysis capability derives from a broader focus on object-oriented technology; (2) object-oriented designs will produce more effective and reusable computer programs when the technology is applied to issues involving complex system interrelationships (more so than when addressing the complex physics of an isolated discipline); and (3) the concept of disposable prototypes is effective for exploratory research programs, but this requires organizations to have a commensurate long-term perspective. This work also suggests that interdisciplinary simulation can be effectively accomplished (over several levels of fidelity) with a mixed language treatment (i.e., FORTRAN-C++), reinforcing the notion the OO technology implementation into simulations is a 'journey' in which the syntax can, by design, continuously evolve. Author

N95-11867*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THE DEVELOPMENT OF A HIGHLY RELIABLE POWER MANAGEMENT AND DISTRIBUTION SYSTEM FOR CIVIL TRANSPORT AIRCRAFT

ANTHONY S. COLEMAN (NYMA, Inc., Brook Park, OH.) and IRVING G. HANSEN Aug. 1994 8 p Presented at the 29th Intersociety Energy Conversion Engineering Conference, Monterey, CA, 8-12 Aug. 1994; cosponsored by AIAA, ASME, IEEE, AIChE, ANS, SAE, and ACS

(Contract(s)/Grant(s): NAS3-27186; RTOP 538-01-11)

(NASA-TM-106697; E-9058; NAS 1.15:106697; AIAA PAPER 94-4107) Avail: CASI HC A02/MF A01

NASA is pursuing a program in Advanced Subsonic Transport (AST) to develop the technology for a highly reliable Fly-By-Light/ Power-By-Wire aircraft. One of the primary objectives of the program is to develop the technology base for confident application of integrated PBW components and systems to transport aircraft to improve operating reliability and efficiency. Technology will be developed so that the present hydraulic and pneumatic systems of the aircraft can be systematically eliminated and replaced by electrical systems. These motor driven actuators would move the aircraft wing surfaces as well as the rudder to provide steering controls for the pilot. Existing aircraft electrical systems are not flight critical and are prone to failure due to Electromagnetic Interference (EMI) (1), ground faults and component failures. In order to successfully implement electromechanical flight control actuation, a Power Management and Distribution (PMAD) System must be designed having a reliability of 1 failure in 10(exp +9) hours, EMI hardening and a fault tolerance architecture to ensure uninterrupted power to all aircraft flight critical systems. The focus of this paper is to analyze, define, and describe technically challenging areas associated with the development of a Power By Wire Aircraft and typical requirements to be established at the box level. The authors will attempt to propose areas of investigation, citing specific military standards and requirements that need to be revised to accommodate the 'More Electric Aircraft Systems'. Author

N95-11890*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

STRUCTURE OF A SWIRL-STABILIZED, COMBUSTING SPRAY

DANIEL L. BULZAN Aug. 1994 30 p Original contains color illustrations

(Contract(s)/Grant(s): RTOP 505-62-12)

(NASA-TM-106724; E-9091; NAS 1.15:106724) Avail: CASI HC A03/MF A01; 1 functional color page

Measurements of the structure of a swirl-stabilized, reacting spray are presented. The configuration consisted of a research air-assist atomizer located in the center surrounded by a coflowing air stream. Both the air assist and coflow streams had swirl imparted to them in the same direction with 45 degree angle swirlers. The fuel and air entered the combustor at ambient temperature and the combustor was operated in an unconfined environment. The gas phase was seeded with aluminum oxide particles in order to obtain velocity measurements. Velocity measurements for the gas phase are reported for both an isothermal, single-phase case without drops and a reacting spray case at axial distances from 2.5 to 350 mm downstream of the nozzle. Both mean and fluctuating values are reported. Heptane fuel was used for all the experiments. Drop size and velocity, and drop number flux are also reported for five axial distances downstream. Both mean and fluctuating values are reported for the drops. The measurements were performed using a two-component phase/Doppler particle analyzer. Profiles across the entire flowfield where velocities were significant are presented. Mean gas phase temperatures were also measured intrusively using a single pt/pt-13 percent rh thermocouple and are reported at axial distances from 2.5 to 200 mm downstream of the nozzle. Author

N95-11901*# Allison Engine Co., Indianapolis, IN.

INVESTIGATION OF ADVANCED COUNTERROTATION BLADE CONFIGURATION CONCEPTS FOR HIGH SPEED TURBOPROP SYSTEMS. TASK 8: COOLING FLOW/HEAT TRANSFER ANALYSIS Final Report, Feb. 1993 - Jun. 1994

EDWARD J. HALL, DAVID A. TOPP, NATHAN J. HEIDEGGER, and ROBERT A. DELANEY Cleveland, OH NASA Sep. 1994 193 p

(Contract(s)/Grant(s): NAS3-25270; RTOP 538-03-11)

(NASA-CR-195359; E-9024; NAS 1.26:195359) Avail: CASI HC A09/MF A03

The focus of this task was to validate the ADPAC code for heat transfer calculations. To accomplish this goal, the ADPAC code was modified to allow for a Cartesian coordinate system capability and to add boundary conditions to handle spanwise periodicity and transpiration boundaries. The primary validation case was the film cooled C3X vane. The cooling hole modeling included both a porous region and grid in each discrete hold. Predictions for these models as well as smooth wall compared well with the experimental data. Author

N95-11951*# Allison Engine Co., Indianapolis, IN.

INVESTIGATION OF ADVANCED COUNTERROTATION BLADE CONFIGURATION CONCEPTS FOR HIGH SPEED TURBOPROP SYSTEMS. TASK 8: COOLING FLOW/HEAT TRANSFER ANALYSIS USER'S MANUAL Final Report

EDWARD J. HALL, DAVID A. TOPP, NATHAN J. HEIDEGGER, and ROBERT A. DELANEY Cleveland, OH NASA Sep. 1994 362 p

(Contract(s)/Grant(s): NAS3-25270; RTOP 538-03-11)

(NASA-CR-195360; E-9025; NAS 1.26:195360) Avail: CASI HC A16/MF A03

The focus of this task was to validate the ADPAC code for heat transfer calculations. To accomplish this goal, the ADPAC code was modified to allow for a Cartesian coordinate system capability and to add boundary conditions to handle spanwise periodicity and transpiration boundaries. This user's manual describes how to use the ADPAC code as developed in Task 5, NAS3-25270, including the modifications made to date in Tasks 7 and 8, NAS3-25270. Author

N95-12860*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

NASA'S HYPERSONIC RESEARCH ENGINE PROJECT: A REVIEW

EARL H. ANDREWS and ERNEST A. MACKLEY Oct. 1994 57 p

(Contract(s)/Grant(s): RTOP 505-70-62-03)

(NASA-TM-107759; NAS 1.15:107759) Avail: CASI HC A04/MF A01

The goals of the NASA Hypersonic Research Engine (HRE) Project, which began in 1964, were to design, develop, and construct a high-performance hypersonic research ramjet/scramjet engine for flight tests of the developed concept over the speed range of Mach 4 to 8. The project was planned to be accomplished in three phases: project definition, research engine development, and flight test using the X-15A-2 research airplane, which was modified to carry hydrogen fuel for the research engine. The project goal of an engine flight test was eliminated when the X-15 program was canceled in 1968. Ground tests of full-scale engine models then became the focus of the project. Two axisymmetric full-scale engine models, having 18-inch-diameter cowls, were fabricated and tested: a structural model and combustion/propulsion model. A brief historical review of the project, with salient features, typical data results, and lessons learned, is presented. An extensive number of documents were generated during the HRE Project and are listed. Author

N95-13289 RAND Corp., Santa Monica, CA.

THE DEVELOPMENT OF THE F100-PW-220 AND F110-GE-100 ENGINES: A CASE STUDY OF RISK ASSESSMENT AND RISK MANAGEMENT

FRANK CAMM 1993 112 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-A282467; RAND/N-3618-AF) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The 'Great Engine War' pitted Pratt and Whitney (P&W) and General Electric (GE) against one another to supply engines, the F100-PW-220 and the F110-GE-100, respectively, for the Air Force's new F-15 and F-16 fighters. Known more formally as the Alternate Fighter Engine competition, this acquisition used 'derivative' engines - engines that incorporated small changes in selected parts of existing engines to greatly improve operability, durability, and the operating and support costs of fighter engines. This note examines the exceptionally successful development programs that created these engines and seeks the basis for that success, giving special attention to risk assessment and risk management in the two development programs. This summary briefly reviews the history of the two developments, raises four basic policy issues revealed by our analysis to be important, and then reviews briefly several lessons offered by these developments for the future. Author

N95-11868*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

EFFECTS OF MASS ON AIRCRAFT SIDEARM CONTROLLER CHARACTERISTICS

CHARLES A. WAGNER Washington Sep. 1994 11 p

(Contract(s)/Grant(s): RTOP 505-68-20)

(NASA-TM-104277; H-2014; NAS 1.15:104277) Avail: CASI HC A03/MF A01

When designing a flight simulator, providing a set of low mass variable-characteristic pilot controls can be very difficult. Thus, a strong incentive exists to identify the highest possible mass that will not degrade the validity of a simulation. The NASA Dryden Flight Research Center has conducted a brief flight program to determine the maximum acceptable mass (system inertia) of an aircraft sidearm controller as a function of force gradient. This information is useful for control system design in aircraft as well as development of suitable flight simulator controls. A modified Learjet with a variable-characteristic sidearm controller was used to obtain data. A boundary was defined between mass considered acceptable and mass considered unacceptable to the pilot. This boundary is defined as a function of force gradient over a range of natural frequencies. This investigation is limited to a study of mass-frequency characteristics only. Results of this investigation are presented in this paper. Author

N95-11869*# Lockheed Engineering and Sciences Co., Hampton, VA.

DETERMINING THE ACCURACY OF MAXIMUM LIKELIHOOD PARAMETER ESTIMATES WITH COLORED RESIDUALS

EUGENE A. MORELLI and VLADISLAV KLEIN Sep. 1994 48 p

(Contract(s)/Grant(s): NAS1-19000; NCC1-29; RTOP 505-64-30-01)

(NASA-CR-194893; NAS 1.26:194893) Avail: CASI HC A03/MF A01

An important part of building high fidelity mathematical models based on measured data is calculating the accuracy associated with statistical estimates of the model parameters. Indeed, without some idea of the accuracy of parameter estimates, the estimates themselves have limited value. In this work, an expression based on theoretical analysis was developed to properly compute parameter accuracy measures for maximum likelihood estimates with colored residuals. This result is important because experience from the analysis of measured data reveals that the residuals from maximum likelihood estimation are almost always colored. The calculations involved can be appended to conventional maximum likelihood estimation algorithms. Simulated data runs were used to show that the parameter accuracy measures computed with this technique accurately reflect the quality of the parameter estimates from maximum likelihood estimation without the need for analysis of the output residuals in the frequency domain or heuristically determined multiplication factors. The result is general, although the application studied here is maximum likelihood estimation of aerodynamic model parameters from flight test data. Author

N95-12664*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

FLIGHT TEST OF TAKEOFF PERFORMANCE MONITORING SYSTEM

DAVID B. MIDDLETON, RAGHAVACHARI SRIVATSAN, and LEE H. PERSON, JR. May 1994 29 p Original contains color illustrations

(Contract(s)/Grant(s): RTOP 505-64-13-04)

(NASA-TP-3403; L-17274; NAS 1.60:3403) Avail: CASI HC A03/MF A01; 8 functional color pages

The Takeoff Performance Monitoring System (TOPMS) is a computer software and hardware graphics system that visually displays current runway position, acceleration performance, engine status, and other situation advisory information to aid pilots in their decision to continue or to abort a takeoff. The system was developed at the Langley Research Center using the fixed-base Transport Systems Research Vehicle (TSRV) simulator. (The TSRV is a highly modified Boeing 737-100 research airplane.) Several versions of the TOPMS displays were evaluated on the TSRV B-737 simulator by more than 40 research, United States Air Force, airline and industry and pilots who rated the system satisfactory and recommended further development and testing. In this study, the TOPMS was flight tested on the TSRV. A total of 55 takeoff and 30 abort situations were investigated at 5 airfields. TOPMS displays were observed on the navigation display screen in the TSRV research flight deck during various nominal and off-nominal situations, including normal takeoffs; reduced-throttle takeoffs; induced-acceleration deficiencies; simulated-engine failures; and several gross-weight, runway-geometry, runway-surface, and ambient conditions. All tests were performed on dry runways. The TOPMS software executed accurately during the flight tests and the displays correctly depicted the various test conditions. Evaluation pilots found the displays easy to monitor and understand. The algorithm provides pretakeoff predictions of the nominal distances that are needed to accelerate the airplane to takeoff speed and to brake it to a stop; these predictions agreed reasonably well with corresponding values measured during several fully executed and aborted takeoffs. The TOPMS is operational and has been retained on the TSRV for general use and demonstration. Author

N95-12763*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

PILOTED EVALUATION OF AN INTEGRATED METHODOLOGY FOR PROPULSION AND AIRFRAME CONTROL DESIGN

MICHELLE M. BRIGHT, DONALD L. SIMON, SANJAY GARG, DUANE L. MATTERN, RICHARD J. RANAUDO, and DENNIS P. ODONOGHUE Sep. 1994 14 p Presented at the Guidance, Navigation and Control Conference, Scottsdale, AZ, 1-3 Aug. 1994;

sponsored by AIAA
(Contract(s)/Grant(s): NAS3-27186; RTOP 505-62-50)
(NASA-TM-106741; E-9149; NAS 1.15:106741; ARL-TR-519; AIAA PAPER 94-3612-CP) Avail: CASI HC A03/MF A01

An integrated methodology for propulsion and airframe control has been developed and evaluated for a Short Take-Off Vertical Landing (STOVL) aircraft using a fixed base flight simulator at NASA Lewis Research Center. For this evaluation the flight simulator is configured for transition flight using a STOVL aircraft model, a full nonlinear turbofan engine model, simulated cockpit and displays, and pilot effectors. The paper provides a brief description of the simulation models, the flight simulation environment, the displays and symbology, the integrated control design, and the piloted tasks used for control design evaluation. In the simulation, the pilots successfully completed typical transition phase tasks such as combined constant deceleration with flight path tracking, and constant acceleration wave-off maneuvers. The pilot comments of the integrated system performance and the display symbology are discussed and analyzed to identify potential areas of improvement.
Author

N95-12791*# Maryland Univ., College Park, MD. Dept. of Electrical Engineering.
TECHNIQUES FOR DESIGNING ROTORCRAFT CONTROL SYSTEMS Final Report, 1 Apr. 1992 - 31 Aug. 1994
GIL YUDILEVITCH and WILLIAM S. LEVINE 1994 121 p
(Contract(s)/Grant(s): NAG2-794)
(NASA-CR-196192; NAS 1.26:196192) Avail: CASI HC A06/MF A02

Over the last two and a half years we have been demonstrating a new methodology for the design of rotorcraft flight control systems (FCS) to meet handling qualities requirements. This method is based on multicriterion optimization as implemented in the optimization package CONSOL-OPTCAD (C-O). This package has been developed at the Institute for Systems Research (ISR) at the University of Maryland at College Park. This design methodology has been applied to the design of a FCS for the UH-60A helicopter in hover having the ADOCS control structure. The controller parameters have been optimized to meet the ADS-33C specifications. Furthermore, using this approach, an optimal (minimum control energy) controller has been obtained and trade-off studies have been performed.
Author

09

RESEARCH AND SUPPORT FACILITIES (AIR)

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

N95-11752# Argonne National Lab., IL.
PARALLEL METHODS FOR THE FLIGHT SIMULATION MODEL
WEI-ZHONG XIONG and C. SWIETLIK 1994 11 p Presented at the ACM/IEEE/SCS Workshop on Parallel and Distributed Simulation, Edinburg, Scotland, 6-8 Jul. 1994
(Contract(s)/Grant(s): W-31-109-ENG-38)
(DE94-013330; ANL/DIS/CP-81788; CONF-940784-1) Avail: CASI HC A03/MF A01

The Advanced Computer Applications Center (ACAC) has been involved in evaluating advanced parallel architecture computers and the applicability of these machines to computer simulation models. The advanced systems investigated include parallel machines with shared memory and distributed architectures consisting of an eight processor Alliant FX/8, a twenty four processor sor Sequent Symmetry, Cray XMP, IBM RISC 6000 model 550, and the Intel Touchstone eight processor Gamma and 512 processor Delta machines. Since parallelizing a truly efficient application program for the parallel machine is a difficult task, the implementation for these machines in a realistic setting has been largely overlooked. The ACAC has developed considerable expertise in optimizing and parallelizing application models on a collection of advanced multiprocessor systems. One of aspect of such an application model is the Flight Simulation Model, which used a set of differential equations to describe the flight characteristics of a launched missile by means of a trajectory. The Flight Simulation Model was written in the FORTRAN language with approximately 29,000 lines of source code. Depending on the number of trajectories, the computation can require several hours to full day of CPU time on DEC/VAX 8650 system. There is an impetus to reduce the execution time and utilize the advanced parallel architecture computing environment available. ACAC researchers developed a parallel method that allows the Flight Simulation Model to be able to run in parallel on the multiprocessor system. For the benchmark data tested, the parallel Flight Simulation Model implemented on the Alliant FX/8 has achieved nearly linear speedup. In this paper, we describe a parallel method for the Flight Simulation Model. We believe the method presented in this paper provides a general concept for the design of parallel applications. This concept, in most cases, can be adapted to many other sequential application programs.
DOE

N95-11789 Naval Facilities Engineering Service Center, Port Hueneme, CA.
MOISTURE INDUCED PRESSURES IN CONCRETE AIRFIELD PAVEMENTS
C. A. KODRES May 1994 105 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A281974; NFESC-TR-2019-ENV) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The erosion of military concrete airfield pavements by jet exhausts is an expensive problem expected to get worse. Scaling of pavements is being observed beneath the auxiliary power units (APU's) of F/A-18 and B-1 aircraft. The AV-8B Harrier and future vertical takeoff and landing aircraft will generate a concrete environment much more severe than that generated by the low power APU's. In order to develop pavements impervious to this form of erosion, the failure mechanism must be known. One plausible culprit, suggested by the apparent role of heating, is moisture. To examine this hypothesis, a mathematical model was developed to predict pore pressures caused by water vapor and air migrating through the pores of a heated section of concrete. The foundation of this model is a constitutive relationship developed to characterize the flow of high velocity, compressible, heated gases through concrete. This relationship equates a nondimensional flow parameter with pressure and temperature ratios across the medium. The key premise is that the resistance to flow through a high resistance porous medium can be modeled with friction coefficients analogous to the method used for simpler geometries. Pore pressures predicted using this model show that moisture in the pores of the cement is unlikely to be the primary cause of material failure in airfield pavements heated by the F/A-1 8 APU. Moisture is a probable cause of failure, however, when the cement is being heated by the exhaust of a Harrier during takeoff and landing.
DTIC

N95-11938*# MCAT Inst., San Jose, CA.
SHOCK-TUNNEL COMBUSTOR TESTING FOR HYPERSONIC VEHICLES Final Report
MARK P. LOOMIS Jul. 1994 33 p
(Contract(s)/Grant(s): NCC2-738)
(NASA-CR-196836; NAS 1.26:196836; MCAT-94-07) Avail: CASI HC A03/MF A01

Proposed configurations for the next generation of transatmospheric vehicles will rely on air breathing propulsion systems during all or part of their mission. At flight Mach numbers greater than about 7 these engines will operate in the supersonic combustion ramjet mode (scramjet). Ground testing of these engine concepts above Mach 8 requires high pressure, high enthalpy facilities such as shock tunnels and expansion tubes. These impulse, or short duration facilities have test times on the order of a millisecond, requiring high speed instrumentation and data systems.

One such facility ideally suited for scramjet testing is the NASA-Ames 16-Inch shock tunnel, which over the last two years has completed a series of tests for the NASP (National Aero-Space Plane) program at simulated flight Mach numbers ranging from 12-16. The focus of the experimental programs consisted of a series of classified tests involving a near-full scale hydrogen fueled scramjet combustor model in the semi-free jet method of engine testing whereby the compressed forebody flow ahead of the cowl inlet is reproduced (see appendix A). The AIMHYE-1 (Ames Integrated Modular Hypersonic Engine) test entry for the NASP program was completed in April 1993, while AIMHYE-2 was completed in May 1994. The test entries were regarded as successful, resulting in some of the first data of its kind on the performance of a near full scale scramjet engine at Mach 12-16. The data was distributed to NASP team members for use in design system verification and development. Due to the classified nature of the hardware and data, the data reports resulting from this work are classified and have been published as part of the NASP literature. However, an unclassified AIAA paper resulted from the work and has been included as appendix A. It contains an overview of the test program and a description of some of the important issues. Derived from text

N95-12216# Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
MARGINAL AGGREGATES IN FLEXIBLE PAVEMENTS: BACKGROUND SURVEY AND EXPERIMENTAL PLAN Final Report, Oct. 1990 - Jun. 1993
RANDY C. AHLRICH and RAYMOND S. ROLLINGS Aug. 1994 57 p
(Contract(s)/Grant(s): DTFA01-90-Z-02069)
(DOT/FAA/CT-94/58; DOT/FAA/RD-93/34) Avail: CASI HC A04/MF A01

The purpose of this study is to evaluate the utilization of substandard or marginal aggregates in flexible pavement construction of airport pavements. This investigation was undertaken to evaluate the effects of using lower quality aggregates such as rounded uncrushed gravels and sands on the rutting of flexible pavements. The scope of this research study included a review of available literature and existing data (Phase 1), a laboratory evaluation organized to determine the effects of marginal aggregates and potential techniques to upgrade these substandard materials (Phase 2), and a field evaluation involving test sections utilizing the most promising techniques (Phase 3). This report provides a review of existing data and literature concerning aggregate properties and their influence on the performance of base course materials and asphalt concrete mixtures. This report also discusses the experimental plan for this research study and provides a discussion and description of the state-of-the-art laboratory testing equipment that is being used to evaluate the engineering properties of the marginal aggregates. A summary and schedule of the remaining work has been included. Author

N95-13200*# Ohio Univ., Athens. Center for Stirling Technology Research.
OSCILLATING-FLOW REGENERATOR TEST RIG Final Report, 1 Apr. 1991 - 26 Sep. 1994
J. G. WOOD and D. R. GEDEON 26 Sep. 1994 34 p
(Contract(s)/Grant(s): NAG3-1269)
(NASA-CR-196982; NAS 1.26:196982) Avail: CASI HC A03/MF A01

This report summarizes work performed in setting up and performing tests on a regenerator test rig. An earlier status report presented test results, together with heat transfer correlations, for four regenerator samples (two woven screen samples and two felt metal samples). Lessons learned from this testing led to improvements to the experimental setup, mainly instrumentation as well as to the test procedure. Given funding and time constraints for this project it was decided to complete as much testing as possible while the rig was set up and operational, and to forego final data reduction and analysis until later. Additional testing was performed on several of the previously tested samples as well an on five newly fabricated samples. The following report is a summary of the work performed at OU, with many of the final test results included in raw data form. Author (revised)

N95-13243 National Aerospace Lab., Amsterdam (Netherlands).
MACH NUMBER CONTROL IN THE HIGH SPEED WIND TUNNEL OF NLR [REGELING VAN HET MACH GETAL IN DE HOGE SNELHEIDS TUNNEL VAN HET NLR]
J. F. T. BOS and P. R. FAASSE 1992 24 p In DUTCH
(PB94-201670; NLR-TP-92371-U) Avail: Issuing Activity (National Technical Information Service (NTIS))

The High Speed Wind Tunnel (HST) of the National Aerospace Laboratory NLR is one of the major transonic windtunnels and is used for aerodynamic research on scale models. The measurements require the control of the Mach number. Two kinds of controller tasks can be distinguished: keeping the Mach number constant, and realizing a different Mach number. When keeping the Mach number constant, substantial disturbances can occur due to a changing angle of attack of the scale model. In the past a PID controller was implemented to counteract these disturbances. The PID controller was only valid in a limited working range of the HST. Therefore, the Mach control system was extended with gain-scheduling techniques and a kind of path-planner for realizing different Mach numbers. Simulation results show that the controller structure yields satisfactory results. NTIS

N95-13553*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SIMULTANEOUS THREE-DIMENSIONAL VELOCITY AND MIXING MEASUREMENTS BY USE OF LASER DOPPLER VELOCIMETRY AND FLUORESCENCE PROBES IN A WATER TUNNEL
DAN H. NEUHART (Lockheed Engineering and Sciences Co., Hampton, VA.), DAVID J. WING, and ULESES C. HENDERSON, JR. Sep. 1994 90 p Original contains color illustrations
(Contract(s)/Grant(s): RTOP 505-62-30-01)
(NASA-TP-3454; L-17328; NAS 1.60:3454) Avail: CASI HC A05/MF A01; 2 functional color pages

A water tunnel investigation was conducted to demonstrate the capabilities of a laser-based instrument that can measure velocity and fluorescence intensity simultaneously. Fluorescence intensity of an excited fluorescent dye is directly related to concentration level and is used to indicate the extent of mixing in flow. This instrument is a three-dimensional laser Doppler velocimeter (LDV) in combination with a fluorometer for measuring fluorescence intensity variations. This capability allows simultaneous flow measurements of the three orthogonal velocity components and mixing within the same region. Two different flows which were generated by two models were studied: a generic nonaxisymmetric nozzle propulsion simulation model with an auxiliary internal water source that generated a jet flow and an axisymmetric forebody model with a circular sector strake that generated a vortex flow. The off-body flow fields around these models were investigated in the Langley 16- by 24-Inch Water Tunnel. The experimental results were used to calculate 17 quantities that included mean and fluctuating velocities, Reynolds stresses, mean and fluctuating dye fluorescence intensities (proportional to concentration), and fluctuating velocity and dye concentration correlations. An uncertainty analysis was performed to establish confidence levels in the experimental results. In general, uncertainties in mean velocities varied between 1 and 7 percent of free-stream velocity; uncertainties in fluctuating velocities varied between 1 and 5 percent of reference values. The results show characteristics that are unique to each type of flow. Author (revised)

N95-13601*# General Motors Corp., Lagrange, IL.
HIGH-SPEED SEAL AND BEARING TEST FACILITY
JEAN B. PANOS *In* NASA. Lewis Research Center, Seals Flow Code Development 1993 235-238 Jul. 1994
Avail: CASI HC A01/MF A03

The following topics are discussed in this viewgraph presentation: high speed seal/bearing rig background, project status, facility features, test rig capabilities, EMD testing advantages, and future opportunities. CASI

10 ASTRONAUTICS

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

N95-11870*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ILLUSTRATED STRUCTURAL APPLICATION OF UNIVERSAL FIRST-ORDER RELIABILITY METHOD
V. VERDERAIME Washington Aug. 1994 41 p
(NASA-TP-3501; M-756; NAS 1.60:3501) Avail: CASI HC A03/MF A01

The general application of the proposed first-order reliability method was achieved through the universal normalization of engineering probability distribution data. The method superimposes prevailing deterministic techniques and practices on the first-order reliability method to surmount deficiencies of the deterministic method and provide benefits of reliability techniques and predictions. A reliability design factor is derived from the reliability criterion to satisfy a specified reliability and is analogous to the deterministic safety factor. Its application is numerically illustrated on several practical structural design and verification cases with interesting results and insights. Two concepts of reliability selection criteria are suggested. Though the method was developed to support affordable structures for access to space, the method should also be applicable for most high-performance air and surface transportation systems. Author

N95-11937*# Lockheed Engineering and Sciences Co., Houston, TX.
AN AXISYMMETRIC ANALOG TWO-LAYER CONVECTIVE HEATING PROCEDURE WITH APPLICATION TO THE EVALUATION OF SPACE SHUTTLE ORBITER WING LEADING EDGE AND WINDWARD SURFACE HEATING
K. C. WANG (Lockheed Engineering and Sciences Co., Houston, TX.) Sep. 1994 143 p
(Contract(s)/Grant(s): NAS9-17900)
(NASA-CR-188343; NAS 1.26:188343) Avail: CASI HC A07/MF A02

A numerical procedure for predicting the convective heating rate of hypersonic reentry vehicles is described. The procedure, which is based on the axisymmetric analog, consists of obtaining the three-dimensional inviscid flowfield solution; then the surface streamlines and metrics are calculated using the inviscid velocity components on the surface; finally, an axisymmetric boundary layer code or approximate convective heating equations are used to evaluate heating rates. This approach yields heating predictions to general three-dimensional body shapes. The procedure has been applied to the prediction of the wing leading edge heating to the Space Shuttle Orbiter. The numerical results are compared with the results of heat transfer testing (OH66) of an 0.025 scale model of the Space Shuttle Orbiter configuration in the Calspan Hypersonic Shock Tunnel (HST) at Mach 10 and angles of attack of 30 and 40 degrees. Comparisons with STS-5 flight data at Mach 9.15 and angle of attack of 37.4 degrees and STS-2 flight data at Mach 12.86 and angle of attack of 39.7 degrees are also given. Author

N95-12175*# Vigyan Research Associates, Inc., Hampton, VA.
A SIMPLE ANALYTICAL AERODYNAMIC MODEL OF LANGLEY WINGED-CONE AEROSPACE PLANE CONCEPT
BANDU N. PAMADI Hampton, VA NASA Oct. 1994 45 p
(Contract(s)/Grant(s): NAS1-19341; RTOP 232-01-04-05)
(NASA-CR-194987; NAS 1.26:194987) Avail: CASI HC A03/MF A01

A simple three DOF analytical aerodynamic model of the Langley Winged-Coned Aerospace Plane concept is presented in a form suitable for simulation, trajectory optimization, and guidance and control studies. The analytical model is especially suitable for methods based on variational calculus. Analytical expressions are presented for lift, drag, and pitching moment coefficients from subsonic to hypersonic Mach numbers and angles of attack up to +/- 20 deg. This analytical model has break points at Mach numbers of 1.0, 1.4, 4.0, and 6.0. Across these Mach number break points, the lift, drag, and pitching moment coefficients are made continuous but their derivatives are not. There are no break points in angle of attack. The effect of control surface deflection is not considered. The present analytical model compares well with the APAS calculations and wind tunnel test data for most angles of attack and Mach numbers. Author (revised)

N95-12507# Air Force Office of Scientific Research, Bolling AFB, Washington, DC.
AFOSR CONTRACTORS MEETING IN PROPULSION
M. A. BIRKAN and J. M. TISHKOFF 13 Jul. 1994 311 p Meeting held in Lake Tahoe, NV, 8-10 Jun. 1994
(Contract(s)/Grant(s): AF PROJ. 2308)
(AD-A282729; AFOSR-TR-94-0463) Avail: CASI HC A14/MF A03

Abstracts are given for research in airbreathing combustion, rocket propulsion, and diagnostics in reacting media supported by the Air Force Office of Scientific Research. DTIC

N95-13196*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PLANAR RAYLEIGH SCATTERING AND LASER-INDUCED FLUORESCENCE FOR VISUALIZATION OF A HOT, MACH 2 ANNULAR AIR JET
R. JEFFREY BALLA Oct. 1994 17 p
(Contract(s)/Grant(s): RTOP 505-70-91-01)
(NASA-TM-4576; L-17374; NAS 1.15:4576) Avail: CASI HC A03/MF A01

Planar Rayleigh scattering (PRS) and planar laser-induced fluorescence (PLIF) were used to investigate the vitiated air component of a coaxial hydrogen/vitiated air nonpremixed turbulent jet flame that is ejected at a Mach number of 2. All experiments were performed with a xenon chloride tunable excimer laser. Planar information for both techniques was obtained using laser sheets 6 cm high, 5 cm wide, and 300 micron thick. In this flow field, the effective Rayleigh cross section of the components in the vitiated air was assumed to be independent of composition. Therefore, the PRS technique produced signals which were proportional to total density. When the flow field was assumed to be at a known and uniform pressure, the PRS signal data for the vitiated air could be converted to temperature information. Also, PLIF images were generated by probing the OH molecule. These images contain striation patterns attributed to small localized instantaneous temperature nonuniformities. The results from the PLIF and PRS techniques were used to show that this flow field contains a nongaseous component, most likely liquid water that can be reduced by increasing the settling chamber wall temperature. Author

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CHEMISTRY AND MATERIALS

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

N95-11796 Institut Franco-Allemand de Recherches, Saint-Louis (France).
SHOCK TUBE INVESTIGATIONS OF COMBUSTION PHENOMENA IN SUPERSONIC FLOWS
G. SMEETS 1993 21 p Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France and Centre de Documentation de l'Armement
(PB94-175262) Avail: Issuing Activity (National Technical Information Service (NTIS))

A survey is given of recent combustion dynamics research using shock tubes. There are three different fields where phenomena in supersonic gas flows resulting from chemical heat release are of particular interest: (1) combustion in an external flow field for lift and thrust generation on hypersonic vehicles, for drag reduction, or for piloting hypervelocity projectiles; (2) scramjet combustor: detailed information on the supersonic combustion can be obtained with 'direct connect' shock tube experiments; and (3) ram acceleration of projectiles in a tube by self-synchronized ignition of a combustible gas mixture. The ignition and combustion processes in the flow field around the high-speed projectile can be studied in an expansion tube.
NTIS

N95-11915*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MODELING AND LIFE PREDICTION METHODOLOGY FOR TITANIUM MATRIX COMPOSITES SUBJECTED TO MISSION PROFILES
M. MIRDAMADI (Analytical Services and Materials, Inc., Hampton, VA.) and W. S. JOHNSON Aug. 1994 37 p
(Contract(s)/Grant(s): RTOP 505-63-50-04)
(NASA-TM-109148; NAS 1.15:109148) Avail: CASI HC A03/MF A01

Titanium matrix composites (TMC) are being evaluated as structural materials for elevated temperature applications in future generation hypersonic vehicles. In such applications, TMC components are subjected to complex thermomechanical loading profiles at various elevated temperatures. Therefore, thermomechanical fatigue (TMF) testing, using a simulated mission profile, is essential for evaluation and development of life prediction methodologies. The objective of the research presented in this paper was to evaluate the TMF response of the (0/90)2s SCS-6/Timetal-21S subjected to a generic hypersonic flight profile and its portions with a temperature ranging from -130 C to 816 C. It was found that the composite modulus, prior to rapid degradation, had consistent values for all the profiles tested. A micromechanics based analysis was used to predict the stress-strain response of the laminate and of the constituents in each ply during thermomechanical loading conditions by using only constituent properties as input. The fiber was modeled as elastic with transverse orthotropic and temperature dependent properties. The matrix was modeled using a thermoviscoplastic constitutive relation. In the analysis, the composite modulus degradation was assumed to result from matrix cracking and was modeled by reducing the matrix modulus. Fatigue lives of the composite subjected to the complex generic hypersonic flight profile were well correlated using the predicted stress in 0 degree fibers.
Author

N95-11968*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TEST MODEL DESIGNS FOR ADVANCED REFRACTORY CERAMIC MATERIALS
HUY KIM TRAN *In its* Technical Paper Contest for Women 1992. Space Challenges: Earth and Beyond p 171-182 1993
Avail: CASI HC A03/MF A03

The next generation of space vehicles will be subjected to severe aerothermal loads and will require an improved thermal protection system (TPS) and other advanced vehicle components. In order to ensure the satisfactory performance system (TPS) and other advanced vehicle materials and components, testing is to be performed in environments similar to space flight. The design and fabrication of the test models should be fairly simple but still accomplish test objectives. In the Advanced Refractory Ceramic Materials test series, the models and model holders will need to withstand the required heat fluxes of 340 to 817 W/sq cm or surface temperatures in the range of 2700 K to 3000 K. The model holders should provide one dimensional (1-D) heat transfer to the samples and the appropriate flow field without compromising the primary test objectives. The optical properties such as the effective emissivity, catalytic efficiency coefficients, thermal properties, and mass loss measurements are also taken into consideration in the design process. Therefore, it is the intent of this paper to demonstrate the design schemes for different models and model holders that would accommodate these test requirements and ensure the safe operation in a typical arc jet facility.
Author

N95-12131# Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
ADDITIVES IN BITUMINOUS MATERIALS AND FUEL-RESISTANT SEALERS Final Report, Oct. 1990 - Jul. 1993
GARY L. ANDERTON and LAURAND H. LEWANDOWSKI Aug. 1994 117 p
(Contract(s)/Grant(s): DTFA01-90-Z-02069)
(DOT/FAA/CT-94/78; DOT/FAA/RD-93/30) Avail: CASI HC A06/MF A02

This report provides a matrix of information on the current state-of-the-art of commercially available additives for bituminous materials and fuel-resistant sealers. Included in this report is a brief history of these types of additives, the results of an airport field survey, descriptions of seven airport site visits, and detailed discussions of a series of laboratory tests used to physically and chemically characterize these additives. A literature search was conducted throughout the study in order to provide the latest information on each reported additive. The information gained from the literature search, field survey, site visits, and laboratory analyses was used to develop an additives database containing information profiles of each additive. The database is presented in hard copy as an appendix of this report, and is also presents in a user-friendly computerized database as a supplement to this report.
Author

N95-12357*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TEN-YEAR GROUND EXPOSURE OF COMPOSITE MATERIALS USED ON THE BELL MODEL 206L HELICOPTER FLIGHT SERVICE PROGRAM
DONALD J. BAKER Sep. 1994 57 p Sponsored by NASA. Langley Research Center and Army Research Lab., Adelphi, MD
(Contract(s)/Grant(s): DA PROJ. 1L1-62211-A-47-AB; RTOP 532-05-37-03)
(NASA-TP-3468; L-17341; ARL-TR-480; NAS 1.60:3468) Avail: CASI HC A04/MF A01

Residual strength results are presented for four composite material systems that have been exposed for up to 10 years to the environment at five different locations on the North American continent. The exposure locations are near where the Bell Model 206L helicopters, which participated in a flight service program sponsored by NASA Langley Research Center and the U.S. Army, were flying in daily commercial service. The composite material systems are (1) Kevlar-49 fabric/F-185 epoxy; (2) Kevlar-49 fabric/LRF-277 epoxy; (3) Kevlar-49 fabric/CE-306 epoxy; and (4) T-300 graphite/E-788 epoxy. Six replicates of each material were removed and tested after 1, 3, 5, 7, and 10 years of exposure. The average baseline strength was determined from testing six as-fabricated specimens. More than 1700 specimens have been tested. All specimens that were tested to determine their strength were painted with a polyurethane paint. Each set of specimens also included an unpainted panel for observing the weathering effects on the composite materials. A statistically based procedure has been used to determine the strength value above which at least 90 percent of the population is expected to fall with a 95-percent confidence level. The computed compression strengths are 80 to 90 percent of the baseline (no-exposure) strengths. The resulting compression strengths are approximately 8 percent below the population mean strengths. The computed short-beam-shear strengths are 83 to 92 percent of the baseline (no-exposure) strengths. The computed tension strength of all materials is 93 to 97 percent of the baseline (no-exposure) strengths. Author

N95-12546 Pratt and Whitney Aircraft, West Palm Beach, FL. Government Engines and Space Propulsion.
FATIGUE IN SINGLE CRYSTAL NICKEL SUPERALLOYS Progress Report, 16 Feb. - 15 May 1994
DANIEL P. DELUCA and CHARLES ANNIS 15 May 1994 12 p
Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): N00014-91-C-0124)
(AD-A283459; PW/GESP-FR21998-23) Avail: CASI HC A03

This program investigates the seemingly unusual behavior of single crystal airfoil materials. The fatigue initiation processes in single crystal (SC) materials are significantly more complicated and involved than fatigue initiation and subsequent behavior of a (single) macrocrack in conventional, isotropic, materials. To understand these differences is the major goal of this project. DTIC

N95-13184# Sandia National Labs., Albuquerque, NM.
CERAMIC MANUFACTURING: OPTIMIZING A MULTIVARIABLE SYSTEM
M. J. READEY 1994 16 p Presented at the 96th Annual Meeting of the American Ceramic Society, Indianapolis, IN, 24-28 Apr. 1994
(Contract(s)/Grant(s): DE-AC04-94AL-85000)
(DE94-015016; SAND-94-1305C; CONF-940416-20) Avail: CASI HC A03/MF A01

Ceramics offer significant performance advantages over other engineering materials in a great number of applications such as turbocharger rotors and wear components. However, to realize their full market potential, ceramics must become more cost competitive. One way to achieve such competitiveness is to maximize manufacturing yield via process optimization. One simple optimization strategy involves maximizing yield by decreasing product variability (e.g., by operating in a regime that is inherently process tolerant). This paper extends this concept to the simultaneous optimization of many material characteristics, which is more typical of the requirements of a real ceramic manufacturing operation. DOE

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ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

A95-60842
CONTROL MECHANISM TO PREVENT CORRELATED MESSAGE ARRIVALS FROM DEGRADING SIGNALING NO. 7 NETWORK PERFORMANCE
HALUK KOSAL AT & T Bell Lab, Holmdel, NJ and RONALD A. SKOOG IEEE Journal on Selected Areas in Communications (ISSN 0733-8716) vol. 12, no. 3 April 1994 p. 439-445 refs
(BTN-94-EIX94341342286) Copyright

Signaling System No. 7 (SS7) is designed to provide a connection-less transfer of signaling messages of reasonable length. Customers having access to user signaling bearer capabilities as specified in the ANSI T1.623 and CCITT Q.931 standards can send bursts of correlated messages (e.g., by doing a file transfer that results in the segmentation of a block of data into a number of consecutive signaling messages) through SS7 networks. These message bursts with short interarrival times could have an adverse impact on the delay performance of the SS7 networks. A control mechanism, Credit Manager, is investigated in this paper to regulate incoming traffic to the SS7 network by imposing appropriate time separation between messages when the incoming stream is too bursty. The credit manager has a credit bank where credits accrue at a fixed rate up to a prespecified credit bank capacity. When a message arrives, the number of octets in that message is compared to the number of credits in the bank. If the number of credits is greater than or equal to the number of octets, then the message is accepted for transmission and the number of credits in the bank is decremented by the number of octets. If the number of credits is less than the number of octets, then the message is delayed until enough credits are accumulated. This paper presents simulation results showing delay performance of the SS7 ISUP and TCAP message traffic with a range of correlated message traffic, and control parameters of the credit manager (i.e., credit generation rate and bank capacity) are determined that ensure the traffic entering the SS7 network is acceptable. The results show that control parameters can be set so that for any incoming traffic stream there is no detrimental impact on the SS7 ISUP and TCAP message delay, and the credit manager accepts a wide range of traffic patterns without causing significant delay. Author (EI)

A95-60871
FIELD-CONSISTENT ELEMENT APPLIED TO FLUTTER ANALYSIS OF CIRCULAR CYLINDRICAL SHELLS
M. GANAPATHI Inst. of Armament Technology, Pune (India), T. K. VARADAN, and J. JIJEN Journal of Sound and Vibration (ISSN 0022-460X) vol. 171, no. 4 April 7, 1994 p. 509-527 refs
(BTN-94-EIX94341341971) Copyright

Supersonic flutter analysis of laminated composite circular cylindrical shells is investigated by using axisymmetric shell finite based on the field-consistency approach. The formulation includes transverse shear deformation and in-plane and rotary inertia effects. The aerodynamic force is evaluated by considering the first order high Mach number approximation to linear potential flow theory. EI

A95-61544* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MARANGONI-BENARD CONVECTION IN A LOW-ASPECT-RATIO LIQUID LAYER
J. C. DUH NASA. Lewis Research Center, Cleveland, OH, US Microgravity Science and Technology (ISSN 0938-0108) vol. 7, no. 2 July 1994 p. 98-109 International Symposium on Microgravity Science and Application (ISMSA), Beijing, China, May 10-13, 1993.
Copyright

This paper presents the results of a study on the variation of the critical Marangoni number (Ma(sub c)) for the onset of Benard convection in a finite liquid layer bounded horizontally as well as from below. A direct-numerical-simulation procedure is devised to determine the Ma(sub c) for aspect ratios (Ar) ranging from 0.8 to 10. The results predict a strong increase of Ma(sub c) as Ar decreases to below 2. A dip of Ma(sub c) occurs between Ar = 1.45 and 1.3, which is accompanied by a pattern transition from a two-cell convection to a unicellular flow. For Ar above 4, the calculated Ma(sub c) shows little change and asymptotically approach a value of 116.15, with Biot number (Bi) equal to 1. Author (Herner)

N95-11711*# General Electric Co., Cincinnati, OH.
ENGINE STRUCTURES ANALYSIS SOFTWARE: COMPONENT SPECIFIC MODELING (COSMO) Final Report
R. L. MCKNIGHT, R. J. MAFFEO, and S. SCHWARTZ Cleveland, OH NASA Aug. 1994 74 p
(Contract(s)/Grant(s): NAS3-26617; RTOP 505-63-5B)
(NASA-CR-195378; E-9093; NAS 1.26:195378) Avail: CASI HC A04/MF A01

A component specific modeling software program has been developed for propulsion systems. This expert program is capable of formulating the component geometry as finite element meshes for structural analysis which, in the future, can be spun off as NURB geometry for manufacturing. COSMO currently has geometry recipes for combustors, turbine blades, vanes, and disks. Component geometry recipes for nozzles, inlets, frames, shafts, and ducts are being added. COSMO uses component recipes that work through neutral files with the Technology Benefit Estimator (T/BEST) program which provides the necessary base parameters and loadings. This report contains the users manual for combustors, turbine blades, vanes, and disks. Author (revised)

N95-11812*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE INTERACTION OF JET NOISE WITH A NEARBY FLEXIBLE STRUCTURE Final Report
J. L. MCGREEVY (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.), A. BAYLISS (Northwestern Univ., Evanston, IL.), and L. MAESTRELLO (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) Jun. 1994 29 p Submitted for publication
(Contract(s)/Grant(s): NAS1-19480; RTOP 505-90-52-01)
(NASA-CR-194934; NAS 1.26:194934; ICASE-94-48) Avail: CASI HC A03/MF A01

The model of the interaction of the noise from a spreading subsonic jet with a panel-stringer assembly is studied numerically in two dimensions. The radiation resulting from this flow/acoustic/structure coupling is computed and analyzed in both the time and frequency domains. The jet is initially excited by a pulse-like source inserted into the flow field. The pulse triggers instabilities associated with the inviscid instability of the jet mean flow shear layer. These instabilities in turn generate sound which provides the primary loading for the panels. The resulting structural vibration and radiation depends strongly on their placement relative to the jet/nozzle configuration. Results are obtained for the panel responses as well as the transmitted and incident pressure. The effect of the panels is to act as a narrow filter, converting the relatively broad band forcing, heavily influenced by jet instabilities, into radiation concentrated in narrow spectral bands. Author

N95-11815*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ACCURATE INTERLAMINAR STRESS RECOVERY FROM FINITE ELEMENT ANALYSIS
ALEXANDER TESSLER and H. RONALD RIGGS Sep. 1994 13 p
(Contract(s)/Grant(s): RTOP 505-63-53-01)
(NASA-TM-109149; NAS 1.15:109149) Avail: CASI HC A03/MF A01

The accuracy and robustness of a two-dimensional smoothing methodology is examined for the problem of recovering accurate interlaminar shear stress distributions in laminated composite and sandwich plates. The smoothing methodology is based on a variational formulation which combines discrete least-squares and penalty-constraint functionals in a single variational form. The smoothing analysis utilizes optimal strains computed at discrete locations in a finite element analysis. These discrete strain data are smoothed with a smoothing element discretization, producing superior accuracy strains and their first gradients. The approach enables the resulting smooth strain field to be practically C1-continuous throughout the domain of smoothing, exhibiting superconvergent properties of the smoothed quantity. The continuous strain gradients are also obtained directly from the solution. The recovered strain gradients are subsequently employed in the integration o equilibrium equations to obtain accurate interlaminar shear stresses. The problem is a simply-supported rectangular plate under a doubly sinusoidal load. The problem has an exact analytic solution which serves as a measure of goodness of the recovered interlaminar shear stresses. The method has the versatility of being applicable to the analysis of rather general and complex structures built of distinct components and materials, such as found in aircraft design. For these types of structures, the smoothing is achieved with 'patches', each patch covering the domain in which the smoothed quantity is physically continuous. Author

N95-11888*# Toledo Univ., OH.
USER'S MANUAL FOR THE NASA LEWIS ICE ACCRETION/HEAT TRANSFER PREDICTION CODE WITH ELECTROTHERMAL DEICER INPUT Final Report
KONSTANTY C. MASIULANIEC and WILLIAM B. WRIGHT Washington NASA Jul. 1994 160 p Sponsored by the FAA
(Contract(s)/Grant(s): NAS3-25517; NAG3-72; RTOP 505-68-10)
(NASA-CR-4530; E-7680; NAS 1.26:4530; DOT/FAA/CT-TN92/33) Avail: CASI HC A08/MF A02

A version of LEWICE has been developed that incorporates a recently developed electrothermal deicer code, developed at the University of Toledo by William B. Wright. This was accomplished, in essence, by replacing a subroutine in LEWICE, called EBAL, which balanced the energies at the ice surface, with a subroutine called UTICE. UTICE performs this same energy balance, as well as handles all the time-temperature transients below the ice surface, for all of the layers of a composite blade as well as the ice layer itself. This new addition is set up in such a fashion that a user may specify any number of heaters, any heater chordwise length, and any heater gap desired. The heaters may be fired in unison, or they may be cycled with periods independent of each other. The heater intensity may also be varied. In addition, the user may specify any number of layers and thicknesses depthwise into the blade. Thus, the new addition has maximum flexibility in modeling virtually any electrothermal deicer installed into any airfoil. It should be noted that the model simulates both shedding and runback. With the runback capability, it can simulate the anti-icing mode of heater performance, as well as detect icing downstream of the heaters due to runback in unprotected portions of the airfoil. This version of LEWICE can be run in three modes. In mode 1, no conduction heat transfer is modeled (which would be equivalent to the original version of LEWICE). In mode 2, all heat transfer is considered due to conduction but no heaters are firing. In mode 3, conduction heat transfer where the heaters are engaged is modeled, with subsequent ice shedding. When run in the first mode, there is virtually identical agreement with the original version of LEWICE in the prediction of accreted ice shapes. The code may be run in the second mode to determine the effects of conduction on the ice accretion process. Author

N95-11996*# Pratt and Whitney Aircraft, West Palm Beach, FL.
HIGH TEMPERATURE STRAIN GAGE TECHNOLOGY FOR GAS TURBINE ENGINES Final Report
EDWARD J. FICHTEL and AMOS D. MCDANIEL Aug. 1994 26 p
(Contract(s)/Grant(s): NAS3-25952)
(NASA-CR-191177; NAS 1.26:191177) Avail: CASI HC A03/MF A01

This report summarizes the results of a six month study that addressed specific issues to transfer the Pd-13Cr static strain sensor to a gas turbine engine environment. The application issues that were addressed include: (1) evaluation of a miniature, variable potentiometer for use as the ballast resistor, in conjunction with a conventional strain gage signal conditioning unit; (2) evaluation of a metal sheathed, platinum conductor leadwire assembly for use with the three-wire sensor; and (3) subjecting the sensor to dynamic strain cyclic testing to determine fatigue characteristics. Results indicate a useful static strain gage system at all temperature levels up to 1350 F. The fatigue characteristics also appear to be very promising, indicating a potential

use in dynamic strain measurement applications. The procedure, set-up, and data for all tests are presented in this report. This report also discusses the specific strain gage installation technique for the Pd-13Cr gage because of its potential impact on the quality of the output data.
Author

N95-12228*# Tennessee Univ. Space Inst., Tullahoma, TN. Center for Space Transportation and Applied Research.
A WALL INTERFERENCE ASSESSMENT AND CORRECTION SYSTEM Final Report, Jun. 1991 - Jun. 1994
C. F. LO Jun. 1994 10 p
(Contract(s)/Grant(s): NAG2-733)
(NASA-CR-196940; NAS 1.26:196940) Avail: CASI HC A02/MF A01

A wall signature method has been selected to be adapted for the Ames 12-ft Wind Tunnel WIAC system. This uses limited measurements of the static pressure at the wall, in conjunction with the solid wall boundary condition, to determine the strength and distribution of singularities representing the test article. The singularities are used to estimate wall interference at the model location. The development and implementation of a working prototype will be completed, delivered and documented with a software manual.
Author (revised)

N95-12843*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ANALYTICAL AND EXPERIMENTAL VIBRATION ANALYSIS OF A FAULTY GEAR SYSTEM
F. K. CHOY (Akron Univ., OH.), M. J. BRAUN (Akron Univ., OH.), V. POLYSHCHUK (Akron Univ., OH.), J. J. ZAKRAJSEK, D. P. TOWNSEND, and R. F. HANDSCHUH Oct. 1994 19 p
Presented at the 1994 Fall Technical Workshop, St. Louis, MO, 24-26 Oct. 1994; sponsored by the American Gear Manufacturers' Association
(Contract(s)/Grant(s): DA PROJ. 1L1-62211-A-47-A; RTOP 505-62-36)
(NASA-TM-106689; E-9045; NAS 1.15:106689; ARL-TR-574) Avail: CASI HC A03/MF A01

A comprehensive analytical procedure was developed for predicting faults in gear transmission systems under normal operating conditions. A gear tooth fault model is developed to simulate the effects of pitting and wear on the vibration signal under normal operating conditions. The model uses changes in the gear mesh stiffness to simulate the effects of gear tooth faults. The overall dynamics of the gear transmission system is evaluated by coupling the dynamics of each individual gear-rotor system through gear mesh forces generated between each gear-rotor system and the bearing forces generated between the rotor and the gearbox structures. The predicted results were compared with experimental results obtained from a spiral bevel gear fatigue test rig at NASA Lewis Research Center. The Wigner-Ville Distribution (WVD) was used to give a comprehensive comparison of the predicted and experimental results. The WVD method applied to the experimental results were also compared to other fault detection techniques to verify the WVD's ability to detect the pitting damage, and to determine its relative performance. Overall results show good correlation between the experimental vibration data of the damaged test gear and the predicted vibration from the model with simulated gear tooth pitting damage. Results also verified that the WVD method can successfully detect and locate gear tooth wear and pitting damage.
Author

N95-12854# National Inst. of Standards and Technology, Gaithersburg, MD. Robot Systems Div.
OVERVIEW OF NASREM: THE NASA/NBS STANDARD REFERENCE MODEL FOR TELEROBOT CONTROL SYSTEM ARCHITECTURE RE
J. S. ALBUS, R. QUINTERO, and R. LUMIA Apr. 1994 14 p See also PB88-123773 and PB89-193940
(PB94-194560; NISTIR-5412) Avail: CASI HC A03/MF A01

The NASA/NBS Standard Reference Model for Telerobot Control System Architecture (NASREM) was developed by the National Institute of Standards and Technology (NIST) for the National Aeronautics and Space Administration (NASA) to provide a software control system architecture guideline for use by development contractors charged with building the Flight Telerobot Servicer (FTS) control system as part of the Freedom Space Station project. The original NASREM document describes a conceptual or domain-independent architecture, and suggests the outline of a functional or domain-specific architecture for FTS. This paper presents an overview of the NASREM conceptual architecture and reviews subsequent work at NIST in defining a functional architecture for the servo and primitive levels. This work suggests outlines for software and hardware architecture specifications, and software development environments to complement the NASREM conceptual and functional architectures.
NTIS

N95-12856*# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
ELECTROMAGNETIC ON-AIRCRAFT ANTENNA RADIATION IN THE PRESENCE OF COMPOSITE PLATES
S. H-T. KAN and R. G. ROJAS Jul. 1994 83 p
(Contract(s)/Grant(s): NAG1-1058)
(NASA-CR-196126; REPT-722792-5; NAS 1.26:196126) Avail: CASI HC A05/MF A01

The UTD-based NEWAIR3 code is modified such that it can model modern aircraft by composite plates. One good model of conductor-backed composites is the impedance boundary condition where the composites are replaced by surfaces with complex impedances. This impedance-plate model is then used to model the composite plates in the NEWAIR3 code. In most applications, the aircraft distorts the desired radiation pattern of the antenna. However, test examples conducted in this report have shown that the undesired scattered fields are minimized if the right impedance values are chosen for the surface impedance plates.
Author

N95-13201*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering.
METHODOLOGY FOR SENSITIVITY ANALYSIS, APPROXIMATE ANALYSIS, AND DESIGN OPTIMIZATION IN CFD FOR MULTIDISCIPLINARY APPLICATIONS Progress Report, 1 Feb. 1993 - 31 Aug. 1994
ARTHUR C. TAYLOR, III and GENE W. HOU Sep. 1994 53 p
Presented at the 5th AIAA/USAF/NASA/OAI Multidisciplinary Design and Optimization Conference, Panama City, FL, Sep. 1994
Submitted for publication
(Contract(s)/Grant(s): NAG1-1265)
(NASA-CR-196981; NAS 1.26:196981; AIAA PAPER 94-4262) Avail: CASI HC A04/MF A01

The straightforward automatic-differentiation and the hand-differentiated incremental iterative methods are interwoven to produce a hybrid scheme that captures some of the strengths of each strategy. With this compromise, discrete aerodynamic sensitivity derivatives are calculated with the efficient incremental iterative solution algorithm of the original flow code. Moreover, the principal advantage of automatic differentiation is retained (i.e., all complicated source code for the derivative calculations is constructed quickly with accuracy). The basic equations for second-order sensitivity derivatives are presented; four methods are compared. Each scheme requires that large systems are solved first for the first-order derivatives and, in all but one method, for the first-order adjoint variables. Of these latter three schemes, two require no solutions of large systems thereafter. For the other two for which additional systems are solved, the equations and solution procedures are analogous to those for the first order derivatives. From a practical viewpoint, implementation of the second-order methods is feasible only with software tools such as automatic differentiation, because of the extreme complexity and large number of terms. First- and second-order sensitivities are calculated accurately for two airfoil problems, including a turbulent flow example; both geometric-shape and flow-condition design variables are considered. Several methods are tested; results are compared on the basis of accuracy, computational time, and computer memory. For first-order derivatives, the hybrid incremental iterative scheme obtained with automatic differentiation is competitive with the best hand-differentiated method; for six independent variables, it is at least two to four times faster than central finite differences and requires only 60 percent more memory than the original code; the performance is expected to improve further in the future. Author

N95-13210*# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
AIRCRAFT WAKE RCS MEASUREMENT
WILLIAM H. GILSON *In* NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 603-623 Jul. 1994 Sponsored by Office of Naval Technology
Avail: CASI HC A03/MF A04

A series of multi-frequency radar measurements of aircraft wakes at altitudes of 5,000 to 25,00 ft. were performed at Kwajalein, R.M.I., in May and June of 1990. Two aircraft were tested, a Learjet 35 and a Lockheed C-5A. The cross-section of the wake of the Learjet was too small for detection at Kwajalein. The wake of the C-5A, although also very small, was detected and measured at VHF, UHF, L-, S-, and C-bands, at distances behind the aircraft ranging from about one hundred meters to tens of kilometers. The data suggest that the mechanism by which aircraft wakes have detectable radar signatures is, contrary to previous expectations, unrelated to engine exhaust but instead due to turbulent mixing by the wake vortices of pre-existing index of refraction gradients in the ambient atmosphere. These measurements were of necessity performed with extremely powerful and sensitive instrumentation radars, and the wake cross-section is too small for most practical applications. Author

N95-13213*# Lightwave Atmospherics, Inc., Marblehead, MA.
REMOTE SENSING OF TURBULENCE IN THE CLEAR ATMOSPHERE WITH 2-MICRON LIDARS
ROBERT J. MARTINSON and JOHN H. FLINT *In* NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 689-705 Jul. 1994
(Contract(s)/Grant(s): DAAH01-92-C-R097)
Avail: CASI HC A03/MF A04

The development of an eye-safe, airborne LIDAR that exploits the decorrelation of the heterodyne signal to detect clear air turbulence is reported. A one watt average power transmitter is capable of detecting clear air turbulence to over 20 km is subvisual cirrus (an environment highly correlated with instabilities of sratified shear layers). In the absence of subvisual cirrus, a 4 km detection range is maintained. A table depicting the warning time in seconds with respect to the aircraft speed and instrument range (in kilometers) is presented. CASI

N95-13215*# TRW, Inc., Redondo Beach, CA. Applications Technology Div.
PASSIVE MMW CAMERA FOR LOW VISIBILITY LANDINGS
MERIT SHOUCRI *In* NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 2 p 765-785 Jul. 1994
Avail: CASI HC A03/MF A04

A passive, millimeter wave imaging sensor for aircraft landing in low or poor visibility conditions is described. The sensor can be incorporated in a camera for future enhanced/synthetic vision systems. Contrast is provided by differences in material reflectivities, temperature, and sky illumination of the scene being imaged. Photographic images of the system's fog penetration capabilities are presented. A combinatorial geometry technique is used to construct the scene geometries. This technique uses eight basic geometric shapes which are used as building blocks for 3-D complex-shaped objects. The building blocks are then combined via union, intersection and exclusion operations to form 3-D scene objects and the combinatorial geometry package determines ray intercepts with scene objects, providing the specific surfaces and propagation distance for the scene. CASI

N95-13235*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ACTIVITIES OF THE STRUCTURES DIVISION, LEWIS RESEARCH CENTER Annual Report, 1990
1990 71 p
(NASA-TM-108081; NAS 1.15:108081; DAAP-LEW-137682) Copyright Avail: CASI HC A04/MF A01

The purpose of the NASA Lewis Research Center, Structures Division's 1990 Annual Report is to give a brief, but comprehensive, review of the technical accomplishments of the Division during the past calendar year. The report is organized topically to match the Center's Strategic Plan. Over the years, the Structures Division has developed the technology base necessary for improving the future of aeronautical and space propulsion systems. In the future, propulsion systems will need to be lighter, to operate at higher temperatures and to be more reliable in order to achieve higher performance. Achieving these goals is complex and challenging. Our approach has been to work cooperatively with both industry and universities to develop the technology necessary for state-of-the-art advancement in aeronautical and space propulsion systems. The Structures Division consists of four branches: Structural Mechanics, Fatigue and Fracture, Structural Dynamics, and Structural Integrity. This publication describes the work of the four branches by three topic areas of Research: (1) Basic Discipline; (2) Aeropropulsion; and (3) Space Propulsion. Each topic area is further divided into the following: (1) Materials; (2) Structural Mechanics; (3) Life Prediction; (4) Instruments, Controls, and Testing Techniques; and (5) Mechanisms. The publication covers 78 separate topics with a bibliography containing 159 citations. We hope you will find the publication interesting as well as useful. Author

N95-13249 Technische Univ., Delft (Netherlands). Ship Hydromechanics Lab.
NUMERICAL TIME DEPENDENT SHEET CAVITATION SIMULATIONS USING A HIGHER ORDER PANEL METHOD Ph.D. Thesis
H. J. DEKONINGGANS 15 Mar. 1994 252 p
(PB94-204435; ISBN-90-6275-965-3) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

This thesis deals with sheet cavitation. The investigation is aimed at profile design with respect to cavitation control. At present it is possible to predict the shape of cavities on an arbitrary two-dimensional profile in stationary flows. To compute the flow around an arbitrary profile, a higher order three-dimensional panel method program has been developed. The main algorithm used in this program is based on a special case of Green's theorem, called 'de Morino formulation'. This computer program (flow program) can calculate the potential on the body and the velocities at the surface of the body or in the flow field. A theoretical method is developed for time simulation of unsteady sheet cavitation. Numerical simulations of the flow around profiles and of cavitation have been carried out. The numerical results of the panel methods have been compared with other calculations of the two-dimensional flow around profiles and of three-dimensional flow around a sphere and a wing. Simulations of the growth of sheet cavitation on a foil have also been carried out. The conclusion is that higher order panel methods are more accurate than the zero order methods. Further refinement of the Kutta condition is required, however. NTIS

N95-13595*# General Electric Co., Lynn, MA. Aircraft Engines.
BRUSH SEALS FOR TURBINE ENGINE FUEL CONSERVATION
MIKE SOUSA *In* NASA. Lewis Research Center, Seals Flow Code Development 1993 p 151-158 Jul. 1994
Avail: CASI HC A02/MF A03

The program objective is to demonstrate brush seals for replacing labyrinth seals in turboprop engines. The approach taken was to design and procure brush seals with assistance from Sealol, modify and instrument an existing T407 low pressure turbine test rig, replace inner balance piston and outer balance piston labyrinth seals with brush seals, conduct cyclic tests to evaluate seal leakage at operating pressures and temperatures, and evaluate effect of seal pack width and rotor eccentricity. Results are presented in viewgraph format and show that brush seals offer performance advantages over labyrinth seals. Derived from text

N95-13599*# Detroit Diesel Allison, Indianapolis, IN.
COMPRESSOR DISCHARGE FILM RIDING FACE SEALS
JOHN MUNSON *In* NASA. Lewis Research Center, Seals Flow Code Development 1993 p 219-226 Jul. 1994
Avail: CASI HC A02/MF A03

Seals examined were the eight-pad Rayleigh step, the tapered spiral groove, and two hydrostatic seals. The spiral groove configuration is the preferred choice because of superior stiffness. Second choice is Rayleigh step because of combined higher operating film thickness and good stiffness at low clearance. Recess hydrostatic has reasonable performance, but stiffness falls off at low clearance. Also, pneumatic hammer characteristics must be investigated. Experience at high pressure ratios is limited. An advantage is that it would have good low speed performance. Derived from text

N95-13600*# Wright Lab., Wright-Patterson AFB, OH. Aero Propulsion and Power Directorate.
AIR FORCE SEAL ACTIVITIES
ELLEN R. MAYHEW *In* NASA. Lewis Research Center, Seals Flow Code Development 1993 p 227-234 Jul. 1994
Avail: CASI HC A02/MF A03

Seal technology development is an important part of the Air Force's participation in the Integrated High Performance Turbine Engine Technology (IHPTET) initiative, the joint DOD, NASA, ARPA, and industry endeavor to double turbine engine capabilities by the turn of the century. Significant performance and efficiency improvements can be obtained through reducing internal flow system leakage, but seal environment requirements continue to become more extreme as the engine thermodynamic cycles advance towards these IHPTET goals. Brush seal technology continues to be pursued by the Air Force to reduce leakage at the required conditions. Likewise, challenges in engine mainshaft air/oil seals are also being addressed. Counter-rotating intershaft applications within the IHPTET initiative involve very high rubbing velocities. This viewgraph presentation briefly describes past and current seal research and development programs and gives a summary of seal applications in demonstrator and developmental engine testing. Author (revised)

N95-13602*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HYPERSONIC ENGINE SEAL DEVELOPMENT AT NASA LEWIS RESEARCH CENTER
BRUCE M. STEINETZ *In its* Seals Flow Code Development 1993 p 239-248 Jul. 1994
Avail: CASI HC A02/MF A03

NASA Lewis Research Center is developing advanced seal concepts and sealing technology for advanced combined cycle ramjet/scramjet engines being designed for the National Aerospace Plane (NASP). Technologies are being developed for both the dynamic seals that seal the sliding interfaces between articulating engine panels and sidewalls, and for the static seals that seal the heat exchanger to back-up structure interfaces. This viewgraph presentation provides an overview of the candidate engine seal concepts, seal material assessments, and unique test facilities used to assess the leakage and thermal performance of the seal concepts. Author (revised)

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GEOSCIENCES

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

N95-11798# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.
TKKMOD: A COMPUTER SIMULATION PROGRAM FOR AN INTEGRATED WIND DIESEL SYSTEM. VERSION 1.0: DOCUMENT AND USER GUIDE
L. M. MANNINEN 10 Dec. 1993 45 p
(ISSN 0358-0741)
(PB94-179090; TKK-F-C155; ISBN-951-22-1910-7) Avail: CASI HC A03/MF A01

The document describes TKKMOD, a simulation model developed at Helsinki University of Technology for a specific wind-diesel system layout, with special emphasis on the battery submodel and its use in simulation. The model has been included into the European wind-diesel modeling software package WDLTOOLS under the CEC JOULE project 'Engineering Design Tools for Wind-Diesel Systems' (JOUR-0078). WDLTOOLS serves as the user interface and processes the input and output data of different logistic simulation models developed by the project participants. TKKMOD cannot be run without this shell. The report only describes the simulation principles and model specific parameters of TKKMOD and gives model specific user instructions. The input and output data processing performed outside this model is described in the documentation of the shell. The simulation model is utilized for calculation of long-term performance of the reference system configuration for given wind and load conditions. The main results are energy flows, losses in the system components, diesel fuel consumption, and the number of diesel engine starts. NTIS

N95-12805 Mitre Corp., Bedford, MA.
THUNDERSTORM HYPOTHESIS REASONER Final Report
ALICE M. MULVEHILL Feb. 1994 31 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): F19628-94-C-0001)
(AD-A282664; MTR-94B0000071) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

THOR is a knowledge-based system which incorporates techniques from signal processing, pattern processing, and artificial intelligence (AI) in order to determine the boundary of small thunderstorms which develop and dissipate over the area encompassed by the Kennedy Space Center and the Cape Canaveral Air Force Station. THOR interprets electric field mill data (derived from a network of electric field mills) by using heuristics and algorithms about thunderstorms that have been obtained from several domain specialists. THOR generates two forms of output: contour plots which visually describe the electric field activity over the network and a verbal interpretation of the activity. THOR uses signal processing and pattern recognition to detect signatures associated with noise or thunderstorm behavior in a near real time fashion from over 31 electrical field mills. THOR's AI component generates hypotheses identifying areas which are under a threat from storm activity, such as lightning. THOR runs on a VAX/VMS at the Kennedy Space Center. Its software is a coupling of C and Fortran programs, several signal processing packages, and an expert system development shell. DTIC

N95-12832*# Harvard Univ., Cambridge, MA. Dept. of Chemistry
DEVELOPMENT OF TECHNIQUES FOR THE IN SITU OBSERVATION OF OH AND HO2 FOR STUDIES OF THE IMPACT OF HIGH-ALTITUDE SUPERSONIC AIRCRAFT ON THE STRATOSPHERE Final Technical Report, 1 Aug. 1990 - 31 Jul. 1993
JAMES G. ANDERSON 8 Sep. 1994 23 p
(Contract(s)/Grant(s): NCC2-693)
(NASA-CR-196759; NAS 1.26:196759) Avail: CASI HC A03/MF A01

This three-year project supported the construction, calibration, and deployment of a new instrument to measure the OH and HO2 radicals on the NASA ER-2 aircraft. The instrument has met and exceeded all of its design goals. The instrumentation represents a true quantum leap in performance over that achieved in previous HO(x) instruments built in our group. Sensitivity for OH was enhanced by over two orders of magnitude as the weight fell from approximately 1500 to less than 200 Kg. Reliability has been very high: HO(x) data are available for all flights during the first operational mission, the Stratospheric Photochemistry, Aerosols, and Dynamics Expedition (SPADE). The results of that experiment have been reported in the scientific literature and at conferences. Additionally, measurements of H2O and O3 were made and have been reported in the scientific literature. The measurements demonstrated the important role that OH and HO2 play in determining the concentration of ozone in the lower stratosphere. During the SPADE, campaign the measurements demonstrated that the catalytic removal is dominated by processes involving the odd-hydrogen and halogen radicals-and extremely important constraint for photochemical models that are being used to assess the potential deleterious effects of super-sonic aircraft effluent on the burden of stratospheric ozone. Derived from text

N95-12855# Environmental Protection Agency, Ann Arbor, MI. Certification Div.
REGULATORY IMPACT ANALYSIS AND REGULATORY SUPPORT DOCUMENT: CONTROL OF AIR POLLUTION; DETERMINATION OF SIGNIFICANCE FOR NONROAD SOURCES AND EMISSION STANDARDS FOR NEW NONROAD COMPRESSION-IGNITION ENGINES AT OR ABOVE 37 KILOWATTS (50 HORSEPOWER) Final Report
T. TRIMBLE, D. R. NORTH, K. A. H. GREEN, M. A. SABOURIN, and D. A. GUERRIERI 27 May 1994 180 p
(PB94-194594) Avail: CASI HC A09/MF A02

The regulatory impact analysis and support document provides additional information in support of the Final Rulemaking (FRM). This FRM will regulate all new nonroad compression-ignition engines greater than or equal to 37 kilowatts (50 hp), except engines which propel or are used on marine vessels, aircraft engines, engines which propel locomotives, and engines regulated by the Mining, Safety, and Health Administration. The regulated engines are hereafter referred to as nonroad large CI engines. The goal of this regulation is to substantially reduce NOx emission and smoke from nonroad large CI engines beginning in the 1996 model year. NTIS

N95-12996# Federal Aviation Administration, Atlantic City, NJ.
TERMINAL DOPPLER WEATHER RADAR BUILD 5A OPERATIONAL TEST AND EVALUATION (OT/E) INTEGRATION AND OT/E OPERATIONAL TEST PLAN
RADAME MARTINEZ, PETER GUTHLEIN, STEVEN VIVEIROS, and DONNE WEDGE Jul. 1994 46 p
(AD-A283052; DOT/FAA/CT-TN94-19) Avail: CASI HC A03/MF A01

The Terminal Doppler Weather Radar (TDWR) Build 5A Enhancement Operational Test and Evaluation (OT&E) Integration and OT&E Operational Test Plan provides the overall philosophy and approach to Build 5A OT&E testing, and identifies OT&E objectives, responsibilities, and resources. The TDWR Build 5A enhancement provides connectivity to the Low Level Wind Shear Alert System (LLWAS) 2 to display LLWAS 2 wind data along with TDWR hazardous weather data on TDWR geographical situation displays (GSD) and ribbon display terminals (RDT). The TDWR Build 5A OT&E is scheduled to occur at the TDWR site in Memphis, TN, March through May 1994. DTIC

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MATHEMATICAL AND COMPUTER SCIENCES

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

A95-60865
MULTIDIMENSIONAL LINES 2: PROXIMITY AND APPLICATIONS
ALFRED INSELBERG IBM Research, Hawthorne, NY and BERNARD DIMSDALE SIAM Journal on Applied Mathematics (ISSN 0036-1399) vol. 54, no. 2 April 1994 p. 578-596 refs
(BTN-94-EIX94341340329) Copyright

To study line proximity, line neighborhoods for a topology are proposed. Results indicate that there are ambiguities in line detection for orthogonal coordinates that are eliminated in parallel coordinates. An application to air traffic control for an information display and an algorithm for collision avoidance are illustrated. EI

N95-11932*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
RESEARCH IN PROGRESS IN APPLIED MATHEMATICS, NUMERICAL ANALYSIS, FLUID MECHANICS, AND COMPUTER SCIENCE Final Semiannual Report, 1 Oct. 1993 - 31 Mar. 1994
Jun. 1994 77 p
(Contract(s)/Grant(s): NAS1-19480; NAS1-18605; NAS1-18107; NAS1-17070; NAS1-17130; NAS1-15810; NAS1-16394; NAS1-14101; NAS1-14472; RTOP 505-90-52-01)
(NASA-CR-194942; NAS 1.26:194942) Avail: CASI HC A05/MF A01

This report summarizes research conducted at the Institute for Computer Applications in Science and Engineering in applied mathematics, fluid mechanics, and computer science during the period October 1, 1993 through March 31, 1994. The major categories of the current ICASE research program are: (1) applied and numerical mathematics, including numerical analysis and algorithm development; (2) theoretical and computational research in fluid mechanics in selected areas of interest to LaRC, including acoustics and combustion; (3) experimental research in transition and turbulence and aerodynamics involving LaRC facilities and scientists; and (4) computer science. Author (revised)

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PHYSICS

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

A95-60790
GEOMETRICAL ACOUSTICS APPROACH FOR CALCULATING THE EFFECTS OF FLOW ON ACOUSTICS SCATTERING
N. ATALLA Univ. de Sherbrooke, Sherbrooke (Quebec) and S. GLEGG Journal of Sound and Vibration (ISSN 0022-460X) vol. 171, no. 5 April 14, 1994 p. 681-694 refs
(BTN-94-EIX94321331207) Copyright

A ray acoustics approach to flow effects on acoustics scattering is considered, based on a combination of geometrical acoustics and the paraxial ray approximation. The approach allows for scattering by objects of arbitrary shapes, inhomogeneous and moving media. Applications to flow effects on scattering include the effect of a wall shear layer on scattering from a cylindrical shaped fuselage and the effects of an incompressible inviscid flow on the directivity pattern of the scattered field from a cylinder and a Rankine body. It has been found that the flow causes a modification and displacement of the lobes of the directivity pattern and the shadow zone of the scattered field, which can be important at Mach numbers greater than 0.2. Author (EI)

A95-60867
ASSESSMENT OF HELICOPTER NOISE ANNOYANCE: A COMPARISON BETWEEN NOISE FROM HELICOPTERS AND FROM JET AIRCRAFT
T. GJESTLAND Acoustics Research, Trondheim, Norway Journal of Sound and Vibration (ISSN 0022-460X) vol. 171, no. 4 April 7 1994 p. 453-458 refs
(BTN-94-EIX94341341967) Copyright

A laboratory study has been conducted to validate the special procedure recommended by Norwegian authorities for assessing helicopter noise annoyance. Noise form helicopters has been subjectively compared with noise from a modern commercial fixed wing jet aircraft. Based on the conclusion of the present study, it is recommended that the same procedures for assessing conventional aircraft noise annoyance be used for both fixed wing and rotary wing without any correction factors. EI

N95-12341*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EN ROUTE NOISE LEVELS FROM PROPFAN TEST ASSESSMENT AIRPLANE
DONALD P. GARBER (Lockheed Engineering and Sciences Co., Hampton, VA.) and WILLIAM L. WILLSHIRE, JR. Sep. 1994 32 p
(Contract(s)/Grant(s): RTOP 535-03-11-02)
(NASA-TP-3451; L-17339; NAS 1.60-3451) Avail: CASI HC A03/ MF A01

The en route noise test was designed to characterize propagation of propfan noise from cruise altitudes to the ground. In-flight measurements of propfan source levels and directional patterns were made by a chase plane flying in formation with the propfan test assessment (PTA) airplane. Ground noise measurements were taken during repeated flights over a distributed microphone array. The microphone array on the ground was used to provide ensemble-averaged estimates of mean flyover noise levels, establish confidence limits for those means, and measure propagation-induced noise variability. Even for identical nominal cruise conditions, peak sound levels for individual overflights varied substantially about the average, particularly when overflights were performed on different days. Large day-to-day variations in peak level measurements appeared to be caused by large day-to-day differences in propagation conditions and tended to obscure small variations arising from operating conditions. A parametric evaluation of the sensitivity of this prediction method to weather measurement and source level uncertainties was also performed. In general, predictions showed good agreement with measurements. However, the method was unable to predict short-term variability of ensemble-averaged data within individual overflights. Although variations in absorption appear to be the dominant factor in variations of peak sound levels recorded on the ground, accurate predictions of those levels require that a complete description of operational conditions be taken into account. The comprehensive and integrated methods presented in this paper have adequately predicted ground-measured sound levels. On average, peak sound levels were predicted within 3 dB for each of the three different cruise conditions. Author

N95-12426# Naval Surface Warfare Center, Bethesda, MD.
LAWS OF INFRARED SIMILITUDE Final Report
PETER O. CERVENKA and LOU MASSA Jan. 1994 29 p
(AD-A282209; CARDIVNSWC-TR-94/002) Avail: CASI HC A03/ MF A01

Accurate physical scale models of complex systems are found to be of great use in fields as diverse as aerodynamics, fluid mechanics, radar, or nuclear physics. It now appears that the concept of scale modeling may offer distinct advantages to those interested in the study of thermodynamic processes that occur in large physical structures. In this investigation, it is shown from a study of the heat equation and its boundary conditions that physical scale modeling can be used to simulate realistic systems operating in realistic outdoor environments. The thermal properties of the construction materials used in the system under study are allowed to vary with position, thus allowing the structure to be divided into a number of compartments. Physical effects which involve heat exchange between the structure and the ocean, or with the atmosphere, are investigated. Both time-dependent and time-independent cases are examined. DTIC

N95-12512 Air Force Inst. of Tech., Wright-Patterson AFB, OH.
IMPINGEMENT FLOW HEAT TRANSFER MEASUREMENTS OF TURBINE BLADES USING A JET ARRAY Ph.D. Thesis
KENNETH W. VANTREUREN Aug. 1994 269 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A283450; AFIT/CI/CIA-94-030D) Avail: CASI HC A12

The requirement for increased gas turbine engine performance has led to the use of much higher turbine entry temperature (TET). The higher temperatures require active cooling of the turbine blade using compressor bleed air. Arrays of impinging jets are one method currently used to reduce the blade temperature on the midspan and leading edge. Air flows through small holes in a blade insert and is directed on the inside surface of a turbine blade to reduce local surface temperature. The engine situation was represented by a 10-20 times scale model tested in the internal cooling transient facility at the University of Oxford. The geometry chosen was for a widely spaced array with a jet spacing of 8d and a plate thickness to jet diameter of 1.2. Experiments were accomplished for a range of impingement plate to target surface spacings, z/d, (1, 2 and 4) and jet Reynolds numbers, Re(sub j), (10,000 - 40,000) with both staggered and inline array hole configurations. The transient liquid crystal technique, both peak intensity narrowband and hue temperature history wideband, enabled the determination of heat transfer coefficient and adiabatic wall temperature. For the first time, local detail of heat transfer on the target surface as well as observation of the crossflow influence on the jet at the target surface are possible. A large variation in heat transfer exists between the stagnation point and channel passage between jets (2-4 times) which was unknown in previous experiments. DTIC

N95-13575 DELAB, Trondheim (Norway).
RESPONSE TO NOISE AROUND VAERNES AND BODOE AIRPORTS
T. GJESTLAND, I. L. N. GRANOEIEN, and K. H. LIASJOE 31 Dec. 1993 63 p
(PB94-207065; STF40-A93136) Avail: Issuing Activity (National Technical Information Service (NTIS))

The report presents the results from social surveys around two airports in Norway. The traffic at these airports consists of a mix of civil and military aircraft. The survey includes three military aircraft exercises with a significant increase in the daily noise levels. These exercises do not seem to alter the respondents' general assessment of noise annoyance. NTIS

N95-11944 RAND Corp., Santa Monica, CA.
CASE STUDY OF RISK MANAGEMENT IN THE USAF B-1B BOMBER PROGRAM
SUSAN J. BODILLY 1993 64 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): F49620-91-C-0003)
(AD-A282371; RAND/N-3616-AF) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

This case study was undertaken in conjunction with six others to develop a better understanding of the risks involved in weapon system development and whether government policies effectively aid in the management of those risks to reduce the probability or severity of negative outcomes. The purpose of the larger study of seven Air Force procurement programs is to provide information that might improve the decision environment in which weapon systems are procured and thus to increase the probability of positive outcomes. This case focuses on the procurement of the B-1B bomber and covers the procurement of the entire aircraft platform and its component systems. The B-1B, with a direct program acquisition cost of $20.5 billion in 1981 dollars, represents a mixed array of technical advances depending on the component part examined. The case study identifies risk-related decisions made early in the program prior to or at the start of full-scale development. The assessments of risk and its subsequent management are then tracked to show how the early risk management decisions affected the program. The term risk, as used throughout this paper, is the probability that, given that an activity is undertaken, an event will occur that has negative outcomes for those involved. This case study (1) identifies acquisition practices that shape and manage risk and (2) suggests possible improvements. DTIC

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SPACE SCIENCES

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

N95-12190*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SCIENCE OBJECTIVES AND PERFORMANCE OF A RADIOMETER AND WINDOW DESIGN FOR ATMOSPHERIC ENTRY EXPERIMENTS
ROGER A. CRAIG (MCAT Inst., Moffett Field, CA.), WILLIAM C. DAVY (Eloret Corp., Santa Clara, CA.), and ELLIS E. WHITING (Eloret Corp., Santa Clara, CA.) Aug. 1994 18 p
(Contract(s)/Grant(s): RTOP 232-01-04)
(NASA-TM-4637; A-94069; NAS 1.15:4637) Avail: CASI HC A03/MF A01

This paper describes the techniques developed for measuring stagnation-point radiation in NASA's cancelled Aeroassist Flight Experiment (AFE). It specifies the need for such a measurement; the types and requirements for the needed instruments; the Radiative Heating Experiment (RHE) developed for the AFE; the requirements, design parameters, and performance of the window developed for the RHE; the procedures and summary of the technique; and results of the arc-jet wind tunnel experiment conducted to demonstrate the overall concept. Subjects emphasized are the commercial implications of the knowledge to be gained by this experiment in connection with the Aeroassisted Space Transfer Vehicle (ASTV), the nonequilibrium nature of the radiation, concerns over the contribution of vacuum-ultraviolet radiation to the overall radiation, and the limit on the flight environment of the vehicle imposed by the limitations on the window material. Results show that a technique exists with which the stagnation-point radiation can be measured in flight in an environment of interest to commercial ASTV applications. Author (revised)

19
GENERAL

N95-12699# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
ACTIVITIES OF THE INSTITUTE FOR AEROSPACE STUDIES OF TORONTO UNIVERSITY Annual Progress Report, 1992 and 1993
1993 119 p Original contains color illustrations Avail: CASI HC A06/MF A02

This annual report highlights activities in both the undergraduate and graduate programs in Aerospace Engineering and provides summary reports on the various experimental facilities and research activities in: Flight Mechanics (flight simulation and air cushion technology); Fluid Mechanics (low speed aerodynamics, aircraft design, nonstationary flows and shock waves, unsteady gas dynamics, aeroacoustics, combustion, propulsion, hypersonic aerodynamics, and computational fluid dynamics); Solid Mechanics (structural mechanics, advanced composites, and materials processing in space); Spacecraft Mechanics (robotics, space dynamics and control); Engineering Physics (applied mass spectroscopy, fusion energy, plasma materials, tokamaks, fiber optic sensors and smart materials and structures). CASI

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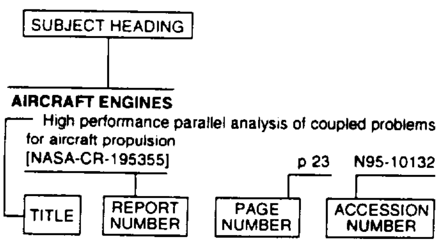

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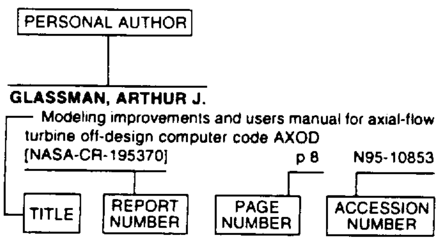

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Typical Corporate Source Index Listing

CORPORATE SOURCE

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High performance parallel analysis of coupled problems for aircraft propulsion
[NASA-CR-195355] p 23 N95-10132

TITLE | REPORT NUMBER | PAGE NUMBER | ACCESSION NUMBER

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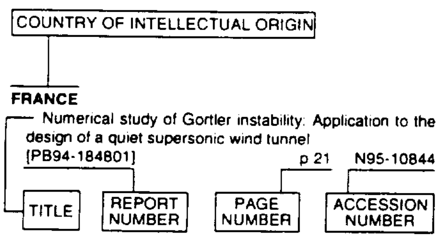

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Typical Contract Number Index Listing

N00014-82-K-0185 .... p 22 N95-10231

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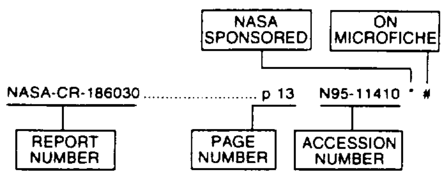
Typical Report Number Index Listing



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Typical Accession Number Index Listing

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N95-10247 * # p 15

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Third Floor, State Capitol
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Phoenix, AZ 85007
(602) 542-3701 Fax: (602) 542-4400

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ARKANSAS STATE LIBRARY
State Library Service Section
Documents Service Section
One Capitol Mall
Little Rock, AR 72201-1014
(501) 682-2053 Fax: (501) 682-1529

CALIFORNIA
CALIFORNIA STATE LIBRARY
Govt. Publications Section
P.O. Box 942837 - 914 Capitol Mall
Sacramento, CA 94337-0091
(916) 654-0069 Fax: (916) 654-0241

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UNIV. OF COLORADO - BOULDER
Libraries - Govt. Publications
Campus Box 184
Boulder, CO 80309-0184
(303) 492-8834 Fax: (303) 492-1881

DENVER PUBLIC LIBRARY
Govt. Publications Dept. BSG
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Denver, CO 80203-2165
(303) 640-8846 Fax: (303) 640-8817

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CONNECTICUT STATE LIBRARY
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Hartford, CT 06106
(203) 566-4971 Fax: (203) 566-3322

FLORIDA
UNIV. OF FLORIDA LIBRARIES
Documents Dept.
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Gainesville, FL 32611-2048
(904) 392-0366 Fax: (904) 392-7251

GEORGIA
UNIV. OF GEORGIA LIBRARIES
Govt. Documents Dept.
Jackson Street
Athens, GA 30602-1645
(706) 542-8949 Fax: (706) 542-4144

HAWAII
UNIV. OF HAWAII
Hamilton Library
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948-8230 Fax: (808) 956-5968

IDAHO
UNIV. OF IDAHO LIBRARY
Documents Section
Rayburn Street
Moscow, ID 83844-2353
(208) 885-6344 Fax: (208) 885-6817

ILLINOIS
ILLINOIS STATE LIBRARY
Federal Documents Dept.
300 South Second Street
Springfield, IL 62701-1796
(217) 782-7596 Fax: (217) 782-6437

INDIANA
INDIANA STATE LIBRARY
Serials/Documents Section
140 North Senate Avenue
Indianapolis, IN 46204-2296
(317) 232-3679 Fax: (317) 232-3728

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UNIV. OF IOWA LIBRARIES
Govt. Publications
Washington & Madison Streets
Iowa City, IA 52242-1166
(319) 335-5926 Fax: (319) 335-5900

KANSAS
UNIV. OF KANSAS
Govt. Documents & Maps Library
6001 Malott Hall
Lawrence, KS 66045-2800
(913) 864-4660 Fax: (913) 864-3855

KENTUCKY
UNIV. OF KENTUCKY
King Library South
Govt. Publications/Maps Dept.
Patterson Drive
Lexington, KY 40506-0039
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LOUISIANA STATE UNIV.
Middleton Library
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Prescott Memorial Library
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Ruston, LA 71272-0046
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UNIV. OF MAINE
Raymond H. Fogler Library
Govt. Documents Dept.
Orono, ME 04469-5729
(207) 581-1673 Fax: (207) 581-1653

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UNIV. OF MARYLAND - COLLEGE PARK
McKeldin Library
Govt. Documents/Maps Unit
College Park, MD 20742
(301) 405-9165 Fax: (301) 314-9416

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BOSTON PUBLIC LIBRARY
Govt. Documents
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Boston, MA 02117-0286
(617) 536-5400, ext. 226
Fax: (617) 536-7758

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DETROIT PUBLIC LIBRARY
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Detroit, MI 48202-4093
(313) 833-1025 Fax: (313) 833-0156

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Govt. Documents Unit
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Lansing, MI 48909
(517) 373-1300 Fax: (517) 373-3381

MINNESOTA
UNIV. OF MINNESOTA
Govt. Publications
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Minneapolis, MN 55455
(612) 624-5073 Fax: (612) 626-9353

MISSISSIPPI
UNIV. OF MISSISSIPPI
J.D. Williams Library
106 Old Gym Bldg.
University, MS 38677
(601) 232-5857 Fax: (601) 232-7465

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UNIV. OF MISSOURI - COLUMBIA
106B Ellis Library
Govt. Documents Sect.
Columbia, MO 65201-5149
(314) 882-6733 Fax: (314) 882-8044

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UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812-1195
(406) 243-6700 Fax: (406) 243-2060

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UNIV. OF NEBRASKA - LINCOLN
D.L. Love Memorial Library
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(402) 472-2562 Fax: (402) 472-5131

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THE UNIV. OF NEVADA LIBRARIES
Business and Govt. Information Center
Reno, NV 89557-0044
(702) 784-6579 Fax: (702) 784-1751

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NEWARK PUBLIC LIBRARY
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Five Washington Street
Newark, NJ 07101-7812
(201) 733-7782 Fax: (201) 733-5648

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UNIV. OF NEW MEXICO
General Library
Govt. Information Dept.
Albuquerque, NM 87131-1466
(505) 277-5441 Fax: (505) 277-6019

NEW MEXICO STATE LIBRARY
325 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827-3824 Fax: (505) 827-3888

NEW YORK
NEW YORK STATE LIBRARY
Cultural Education Center
Documents/Gift & Exchange Section
Empire State Plaza
Albany, NY 12230-0001
(518) 474-5355 Fax: (518) 474-5786

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UNIV. OF NORTH CAROLINA - CHAPEL HILL
Walter Royal Davis Library
CB 3912, Reference Dept.
Chapel Hill, NC 27514-8890
(919) 962-1151 Fax: (919) 962-4451

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NORTH DAKOTA STATE UNIV. LIB.
Documents
P.O. Box 5599
Fargo, ND 58105-5599
(701) 237-8886 Fax: (701) 237-7138

UNIV. OF NORTH DAKOTA
Chester Fritz Library
University Station
P.O. Box 9000 - Centennial and University Avenue
Grand Forks, ND 58202-9000
(701) 777-4632 Fax: (701) 777-3319

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STATE LIBRARY OF OHIO
Documents Dept.
65 South Front Street
Columbus, OH 43215-4163
(614) 644-7051 Fax: (614) 752-9178

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OKLAHOMA DEPT. OF LIBRARIES
U.S. Govt. Information Division
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Oklahoma City, OK 73105-3298
(405) 521-2502, ext. 253
Fax: (405) 525-7804

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Edmon Low Library
Stillwater, OK 74078-0375
(405) 744-6546 Fax: (405) 744-5183

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PORTLAND STATE UNIV.
Branford P. Millar Library
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Portland, OR 97207-1151
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(717) 787-3752 Fax: (717) 783-2070

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CLEMSON UNIV.
Robert Muldrow Cooper Library
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Clemson, SC 29634-3001
(803) 656-5174 Fax: (803) 656-3025

UNIV. OF SOUTH CAROLINA
Thomas Cooper Library
Green and Sumter Streets
Columbia, SC 29208
(803) 777-4841 Fax: (803) 777-9503

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UNIV. OF MEMPHIS LIBRARIES
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Memphis, TN 38152-0001
(901) 678-2206 Fax: (901) 678-2511

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TEXAS STATE LIBRARY
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Austin, TX 78701-0001
(512) 463-5455 Fax: (512) 463-5436

TEXAS TECH. UNIV. LIBRARIES
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Lubbock, TX 79409-0002
(806) 742-2282 Fax: (806) 742-1920

UTAH
UTAH STATE UNIV.
Merrill Library Documents Dept.
Logan, UT 84322-3000
(801) 797-2678 Fax: (801) 797-2677

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UNIV. OF VIRGINIA
Alderman Library
Govt. Documents
University Ave. & McCormick Rd.
Charlottesville, VA 22903-2498
(804) 824-3133 Fax: (804) 924-4337

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16th and Water Streets
Olympia, WA 98504-2478
(206) 753-4027 Fax: (206) 586-7575

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Govt. Documents Section
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Morgantown, WV 26506-6069
(304) 293-3051 Fax: (304) 293-6638

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Madison, WI 53706
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MILWAUKEE PUBLIC LIBRARY
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