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AERONAUTICAL ENGINEERING

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Supplement 63

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NASA SP-7037 (63)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 63

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in October 1975 in

- *Scientific and Technical Aerospace Reports (STAR)*
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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering The first issue of this bibliography was published in September 1970 and the first supplement in January 1971 Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 340 reports, journal articles, and other documents originally announced in October 1975 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

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.

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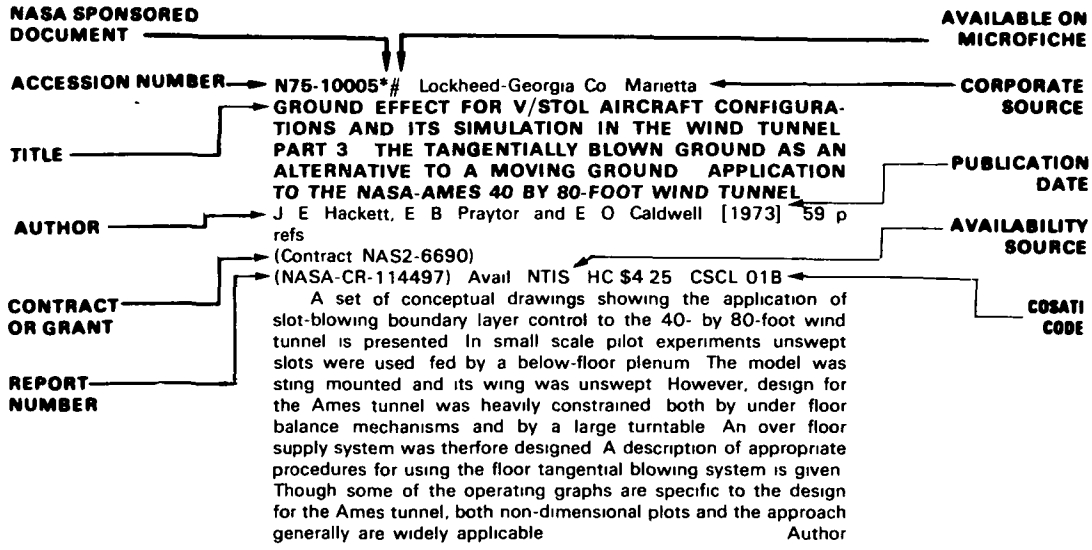

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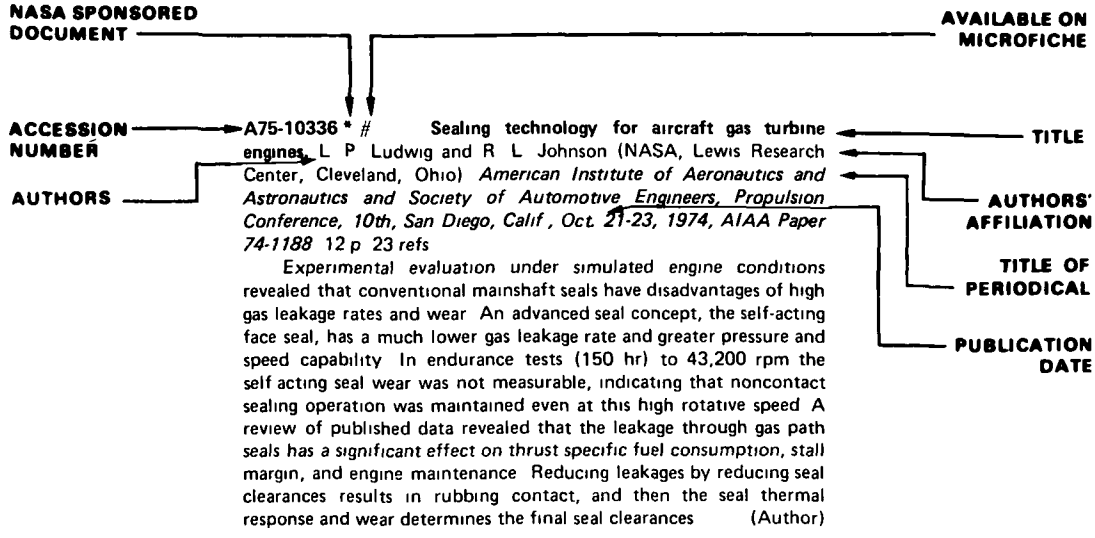

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 63) NOVEMBER 1975

IAA ENTRIES

A75 38901 **Fiber composite structures** M Salkind (Avco Corp, Avco Systems Div, Lowell, Mass) *JOM/Journal of Metals*, vol 27, May 1975, p 15-19 19 refs

The advent of boron, graphite and Kevlar fibers, and the rediscovery of glass fibers for highly loaded structures have revived interest in the use of composites for aerospace applications and for sporting equipment, high-speed machinery, automobiles, etc Characteristics of composites which make designing with them different from designing with metals are considered The nearly linear behavior to fracture and lack of plastic yielding is typical for most composites The fatigue behavior shows a variety of failure modes including fiber-matrix debonding, delamination, fiber breakage and matrix cracking Due to the flat nature of the S N curve, composites are highly fatigue resistant and their relative sensitivity to stress concentrations in fatigue is the opposite to that of metals Test and service experience indicate that composite structures are safer and more reliable than metals Advanced development of eutectic composites for applications in the hottest parts of the turbine engine should provide improved efficiency by increasing allowable metal temperatures M G

A75-39017 **Anglo-American Aeronautical Conference, 14th, Los Angeles, Calif, August 4-7, 1975, Technical Papers** Conference sponsored by the American Institute of Aeronautics and Astronautics, Canadian Aeronautics and Space Institute, and Royal Aeronautical Society New York, American Institute of Aeronautics and Astronautics, Inc, 1975 82 p

The present collection of papers deals with airline fuel problems, several important aspects of advanced cargo aircraft systems, and future trends in civil aircraft operation in the so-called terminal movement area Also discussed are the overall program for the design and development of the supersonic fighter-trainer aircraft Jaguar and the use of a 5 x 5 ft wind tunnel with a high Reynolds number for the development of modern airfoil sections The potential of new subsonic transport aircraft designs that may evolve in the relatively near future is examined along with prospective heat-exchange aircraft engines in which the heat-exchanger cycle still remains impractical until further progress in structural design and materials is achieved

Individual items are announced in this issue S D

A75-39019 # **The challenge to advanced cargo aircraft systems** F A Cleveland (Lockheed Aircraft Corp, Burbank, Calif) In Anglo-American Aeronautical Conference, 14th, Los Angeles, Calif, August 4-7, 1975, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1975 11 p

The paper deals with the potential of advances in individual technologies, assesses the economic promise when integrated into total systems, and presents some conclusions defining a few of the most likely possibilities Six areas of advanced technology are discussed superficial aerodynamics, friction drag reduction, induced drag reduction, active controls, composite materials, and improved specific fuel consumption Economic viability is examined along with benefits of advanced technology and larger-sized aircraft The modular approach to a family design with maximum commonality offers a possibility that could be applied across a broad spectrum of potential air cargo transports Whether derivatives or new systems prevail, only through persistent research and development efforts can the many potential improvements in fuel conservation, other operational cost factors, and production costs be realized S D

A75-39021 # **European collaborative military aircraft programme - Jaguar** I R Yates (British Aircraft Corp, Ltd, Preston, Lancs, England) In Anglo-American Aeronautical Conference, 14th, Los Angeles, Calif, August 4-7, 1975, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1975 11 p

The overall program for the design and development of the Anglo-French tactical fighter-trainer supersonic aircraft called Jaguar is described The discussion covers the background of Anglo-French collaboration and management in solving problems associated with the airframe and engines of the Jaguar Considerable wind tunnel testing is done and great care is taken to shape the rear fuselage lines above the jets to minimize base drag Changes between the first prototype and the final production aircraft are examined The production and in-service phase is outlined S D

A75-39022 # **The role of the NAE 5x5 foot wind tunnel in the development of modern airfoil sections** L H Ohman (National Research Council, Ottawa, Canada) In Anglo-American Aeronautical Conference, 14th, Los Angeles, Calif, August 4-7, 1975, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1975 16 p 33 refs

A brief history of this unique facility is given, followed by a description of certain features added in recent years to enhance the facility's usefulness in modern airfoil development, by providing data at realistic Reynolds numbers, particularly at transonic speeds The characteristics of a large variety of airfoils have been investigated, classical NACA sections, super critical airfoils, jet flap and augmentor wing sections as well as airfoils with mechanical high lift devices Selective results from these investigations are presented, demonstrating the effect of Reynolds number on airfoil characteristics and the potentials of recent advances in section design with regard to drag, lift and buffetting (Author)

A75-39023 * # **Advanced subsonic aircraft concepts for passenger transportation** M H Waters and L J Williams (NASA, Ames Research Center, Moffett Field, Calif) In Anglo-American Aeronautical Conference, 14th, Los Angeles, Calif, August 4-7, 1975, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc, 1975 8 p 10 refs

This paper discusses the potential for new subsonic transport aircraft designs that may evolve in the relatively near future, taking into account the added requirements for improved environmental compatibility and the potential constraints due to system congestion, substantial financial risk, and higher fuel costs or limited availability Reflecting these additional requirements, potential aircraft developments are presented for new CTOL transports with significantly improved fuel economy, new STOL transports with improved short field capability, and new VTOL transports that could provide direct city-center service (Author)

A75-39084 **Instrumentation requirements relative to federal aircraft emission regulations** W T Westfield (FAA, Washington, D C) and G D Kittredge (U S Environmental Protection Agency, Washington, D C) In International Instrumentation-Automation Conference, New York, N Y , October 28-31, 1974, Proceedings Part 2 Pittsburgh, Instrument Society of America, 1974, p 632 1-632 5 *10 refs*

A description is given of the views of the Environmental Protection Agency and the Federal Aviation Administration with regard to the pollutant sampling and measurement requirements embodied in the Federal aircraft emission regulations The pollutants which are to be measured are considered along with pollutant sampling and measurement problems characteristic of turbine exhaust Questions regarding measurement instrumentation are discussed and attention is given to the role of government/industry information exchange G R

A75-39090 **The employment of Kalman filter technology for the improvement of the signal quality of a microwave beacon system (Anwendung der Kalman-Filtertechnik zur Verbesserung der Qualitat der Signale eines Mikrowellenleitstrahlsystems)** P Wust (Bodenseewerk Geratetechnik GmbH, Uberlingen, West Germany) In Applications of the Kalman filter technique in the Federal Republic of Germany, Joint Meeting, Frankfurt am Main, West Germany, November 27, 1974, Reports Dusseldorf, Deutsche Gesellschaft fur Ortung und Navigation, 1974, p 75-92, Discussion, p 93, 94 In German Research supported by the Bundesministerium der Verteidigung

It is planned to increase the steepness of the angle at aircraft takeoff in order to reduce the molestation by aircraft noise The information required by the flight control system and the flight-path control device for such a maneuver will be provided by a microwave system Two filter designs for such a system are discussed The merits of one filter design have already been studied in a flight test The second design is still in a state of development The equations of the discrete Kalman filter algorithm are considered along with the equations of a sensitivity analysis G R

A75-39220 # **The effect of the surface roughness of blade profiles on the flow characteristics of a turbine (Der Einfluss der Oberflachenrauhigkeit von Schaufelprofilen auf das stromungstechnische Verhalten einer Turbine)** H Sandstede Hannover, Technische Universitat, Fakultat fur Maschinenwesen, Dr -Ing Dissertation, 1974 183 p 50 refs In German Research supported by the Deutsche Forschungsgemeinschaft

The flow characteristics in the case of a four-stage turbine were investigated for various blade roughness magnitudes It was observed that blade roughness had the greatest effect on turbine-efficiency values Effects of blade roughness on the operational characteristics of the turbine were also observed Computations based on a procedure reported by Bammert and Fiedler (1964) were conducted, taking into account the conditions considered in the experimental investigations Computed values and experimental data are compared G R

A75-39223 # **Impact of a flight vehicle on a spherical shell (Stoss eines Flugkorpers auf eine Kugelschale)** J W Hammel Darmstadt, Technische Hochschule, Fachbereich Mechanik, Dr -Ing Dissertation, 1974 105 p 47 refs In German

An analysis is conducted of the stresses that are produced in structures which are subjected to an impact involving a flight vehicle The deformations of the flight vehicle and of the structure are taken into account The characteristics of the flight vehicle are approximated with the aid of a spring-mass system with dashpot dampening The structures considered include a planar plate and a spherical shell It is assumed that the deformations will be in the linear elastic range The shell displacements for a number of computed impulsive load characteristics are determined G R

A75-39224 # **A theory for the calculation of conical paragliders with weak camber in supersonic flow (Eine Theorie zur Berechnung konischer Paragleiter mit schwacher Wolbung in Uberschallstromung)** B Wagner Darmstadt, Technische Hochschule, Fachbereich Maschinenbau, Dr -Ing Dissertation, 1975 267 p 62 refs In German

The investigation makes use of a linearized supersonic airfoil theory to study the characteristics of paraglider operation under supersonic conditions It is pointed out that, because of the employment of the linearized theory, only small angles of attack and small camber values can be considered There is, however, no upper limit for the aspect ratio A linear integral equation for the representation of the problem is developed This equation makes it possible to use the methods of linear integral-equation theory for the analysis G R

A75-39268 **Review of presently employed narrow-beam microwave antennas II (Übersicht der heute in der Technik verwendeten stark bundelnden Mikrowellenantennen II)** G v Trentini (Siemens AG, Munich, West Germany) *Frequenz,* vol 29, July 1975, p 192-199 28 refs In German

Antennas with doubly curved reflectors and an unsymmetric radiation lobe are considered along with antennas with variable radiation characteristics for aircraft radar system, antennas for beam-scanning applications, multiple-beam antennas, monopulse antennas for airborne radar, and antennas with electronic beam control Attention is given to phase-controlled antennas, planar array antennas for electronic beam scanning, a cylindrical phased-array antenna for air traffic control, and array and reflector techniques for airport precision approach radars G R

A75-39321 **The airship debate** E Mowforth (Surrey, University, Guildford, Airfloat Transport, Ltd , England) *New Scientist,* vol 67, July 10, 1975, p 70-73

Big airships were never built in sufficient numbers either to involve sufficient capital for necessary research and development or to generate an adequate reserve of operating experience Present day airship studies are directed predominantly towards heavy freight movement, operating in competition with surface transport The Airfloat HL project which has a helium capacity of 1,342,000 cu m and is designed to carry a 500 ton payload over moderate ranges is used as a basis for discussion A study of the implications of helium heating suggests that further work be done Future airships applications lie in tasks where its peculiarities constitute an advantage over other types of aircraft, or in roles which lie entirely beyond the capacity of other aircraft or of competitive ground systems Other applications discussed, such as use in disaster relief, ranging from air-sea rescue to lifting wrecked trains or hauling emergency supplies are too costly when compared to the conventional services now in use M G

A75-39324 **The choice of the MLS technique in the United States (Le choix de la technique M L S aux Etats-Unis)** P Fombonne (Thomson CSF, Paris, France) *Navigation* (Paris), vol 23, July 1975, p 295-308 In French

Reasons for the choice of MLS over Doppler scanning as a new navigation technique to replace ILS are given, and the history of the making of the choice is delineated The four key questions in this controversy were developmental risks, the application of the selected technology to multiple trajectories, functional monitoring capacity, *and cost considerations* In addition, the French point of view and benefits to be gained by the French from the struggle in the U S are discussed S J M

A75-39330 # **Vibration tests of a structure with dry friction (Essais de vibration d'une structure comportant du frottement sec)** R Dat, R Tretout, and J -M. Lafont (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *La Recherche Aérospatiale,* May-June 1975, p 169 174 In French

It is shown that the application of an auxiliary high-frequency periodic excitation to reduce dry friction on a structure provides the structure with a linear behavior for any excitation at a frequency much lower than the auxiliary excitation frequency The method is particularly useful in vibration tests of gliders and light airplanes
S J M

A75-39331 # **Introduction of unsteady separation into acceleration potential theory - Application to the helicopter (Introduction du décollement instationnaire dans la théorie du potentiel d'accélération - Application à l'hélicoptère)** J J Costes (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *La Recherche Aérospatiale*, May-June 1975, p 175-188 8 refs In French

A means of predicting unsteady lift forces and separation on a helicopter rotor is presented A correction is introduced into acceleration potential theory based on empirical data in order to achieve this end Calculations are made for fixed and oscillating two-dimensional profiles, and nonlinearities in lift coefficient curves are taken into account The method is then extended to the three-dimensional case of a finite-span wing and a rotor blade The generalization of the linear potential theory to include unsteady separations is accomplished by replacing the incidence of an entire blade by a smaller effective incidence
S J M

A75-39334 # **The control of aircraft noise** J B Large (Southampton, University, Southampton, England) *Aircraft Engineering*, vol 47, July 1975, p 4 6, 8-10, 35 15 refs

The development of noise control is reviewed from the lobed nozzles and tubular jet noise suppressore used for the first family of jet-powered aircraft to acoustic liners, current operational procedures and future technology for diminished aircraft noise Community response can be related to noise exposure The characteristics that combine to produce annoyance due to aircraft noise include fear, susceptibility, distance adaptability, misfeasance-preventability, and physical noise exposure To increase community acceptance, all of the following features must be considered noise from the aircraft, aircraft operation, land use planning in the airport neighborhood, and along the incoming and outgoing flight tracks The noise sources discussed include jet, turbine, fan and compressor noise, shock wave shedding from the blade tips causing 'buzz saw', and the noise caused by the high by-pass ratio engine Operational procedures aimed at noise reduction, such as two segment approach procedure must take into account a wide margin of safety
M G

A75-39340 # **Influence of rigidity and damping in an elevator control system on the longitudinal stability of an aircraft and on elevator vibrations (Wplyw sztywnosci i tlumienia w ukladzie sterowania sterem wysokosci na statecznosc podluzna samolotu i oscylacje steru)** J Maryniak and Z Goraj (Warszawa, Politechnika, Warsaw, Poland) *Mechanika Teoretyczna i Stosowana*, vol 13, no 2, 1975, p 261 281 14 refs In Polish

The influence of elevator stiffness, damping, and balance on aircraft stability and elevator vibrations is examined The equations of motion for an aircraft with a vibrating elevator are derived using the Boltzmann-Hamel equations for holonomic systems The solution is shown to reduce to a determination of the eigenvalues and corresponding eigenvectors of the matrix of state Numerical calculations are performed for a light aircraft, and the results are compared with those obtained for an aircraft with a rigid elevator
F G M

A75-39350 # **The experimental cascade performance of NACA compressor profiles at low Reynolds number** W B Roberts (Westinghouse Electric Corp , General Compressor Development Group, Sunnyvale, Calif) *ASME, Transactions, Series A Journal of Engineering for Power*, vol 97, July 1975, p 454-459 5 refs

A75-39351 **Aerospace sandwich materials (Matériaux sandwich aérospatiaux)**. S Dzalba-Lyndis (Societé Nationale Industrielle Aérospatiale, Paris, France) *Matériaux et Techniques*, vol 63, June-July 1975, p 267-276 In French

The production of wave-shaped soldered cores for flat materials is reviewed In particular, properties of the sandwich material known as Norsial are outlined Various size scales and alloy compositions for the wave-shaped sandwich cores have been employed Different machines used for manufacturing different types of undulating cores are described
S J M

A75-39402 **Structure interpretation by consideration of vibration resistance in light construction (Strukturauslegung unter Berucksichtigung der Schwingfestigkeit im Leichtbau)** K Hoffer (Vereinigte Flugtechnische Werke - Fokker GmbH, Bremen, West Germany) *VDI-Z*, vol 117, no 13-14, July 1975, p 608-612 In German

The influence of notches on the cyclic stress resistance of light construction materials is investigated, and the use of mechanical preparation methods to diminish stress concentrations and improve fatigue life properties is examined Stress corrosion cracking as a factor in these processes is also considered It is shown that the choice of materials has much to do with cyclic loading behavior, but that high-crack-resistant materials are often more notch-sensitive than low-crack resistant materials Mechanical remedies to notch production include curling, extrusion, and shot peening
S J M

A75-39482 * # **Processable high temperature resistant polymer matrix materials** T T Serafini (NASA, Lewis Research Center, Polymer Matrix Composites Section, Cleveland, Ohio) *Metallurgical Society of AIME, International Conference on Composite Materials, Geneva, Switzerland, Apr 7-11, 1975, and Boston, Mass , Apr 14-18, 1975, Paper* 19 p 9 refs

A review is presented of studies conducted with addition-cured polyimides, giving particular attention to an improved method involving in situ polymerization of monomer reactants (PMR) on the surface of the reinforcing fibers The studies show that the PMR approach provides a powerful method for fabricating high performance polymer matrix composites Significant advantages of the PMR approach are related to the superior high temperature properties of the obtained material, lower cost, greater safety, and processing versatility
G R

A75-39483 * # **Metal matrix composites for aircraft propulsion systems** R A Signorelli (NASA, Lewis Research Center, Cleveland, Ohio) *Metallurgical Society of AIME, International Conference on Composite Materials, Geneva, Switzerland, Apr 7-11, 1975, and Boston, Mass , Apr 14-18, 1975, Paper* 23 p 26 refs

A report is presented of the current status of development of five materials which might be used in the design of components for advanced aircraft propulsion systems Boron fiber/aluminum, boron fiber/titanium, and silicon carbide fiber/titanium composites are considered for lightweight compressor fan blades Directionally solidified eutectic superalloy and tungsten wire/superalloy composites could possibly be used in the design of turbine blades for operational temperatures as high as 1100 C
G R

A75-39491 * # **Simultaneous calculation of aircraft design loads and structural member sizes** G L Giles (NASA, Langley Research Center, Structures and Dynamics Div , Hampton, Va) and L A McCullers (LTV Aerospace Corp , Hampton, Va) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75 965* 10 p 16 refs

A design process which accounts for the interaction between aerodynamic loads and changes in member sizes during sizing of aircraft structures is described A simultaneous iteration procedure is used wherein both design loads and member sizes are updated during

each cycle yielding converged, compatible loads and member sizes A description is also given of a system of programs which incorporates this process using lifting surface theory to calculate aerodynamic pressure distributions, using a finite-element method for structural analysis, and using a fully stressed design technique to size structural members This system is tailored to perform the entire process with computational efficiency in a single computer run so that it can be used effectively during preliminary design Selected results, considering maneuver, taxi, and fatigue design conditions, are presented to illustrate convergence characteristics of this iterative procedure (Author)

A75-39492 # **The concept of an interactive graphic design system /IGDS/ with distributed computing** C W Klomp, R A Gern, and W W Braithwaite (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75 966* 9 p 7 refs

The subject system is a distributed two and three-dimensional interactive graphics system Its prime elements are minicomputer subsystems on which design construction, editing, manipulation, and verification are performed in support of the aerospace vehicle design process These subsystems are tailored to specific departmental requirements and, hence, are configured to support explicit needs Such configurating permits the incorporation of whatever graphic medium is required (storage tubes, refresh tubes, flatbed, or drum plotters) Each subsystem represents a node in a network consisting of many such graphic subsystems, nongraphic subsystems, and a number of large-scale mainframes for providing additional processing power and the management of shared data bases This paper explains why this approach was chosen rather than an approach utilizing a single mainframe on which all activities are performed In addition, a number of applications are presented and the inherent flexibility of the approach, as well as expansion or retraction capabilities, are discussed (Author)

A75-39493 # **Test results on computer graphics productivity for aircraft design and fabrication** A Feder (Northrop Corp , Aircraft Div , Hawthorne, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75 967* 11 p

An experiment performed to determine the feasibility and advantages of CADAM (computer-augmented design and manufacturing) is described A cathode-ray tube (CRT) refresh system and a CRT storage system are recommended on the basis of the results Productivity ratios were as high as 17/1 compared with manual methods Productivity ratios were obtained from design experts and trainees by applying a normalizing learning curve and a consistent 15% factor to account for computer downtime and other operating inefficiencies S J M

A75-39494 # **C-5A air launch of Minuteman I missile** J E Leger (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-969* 9 p

This paper discusses the general engineering-approach used to adapt existing cargo handling ground equipment, aircraft on-board cargo subsystems, and previously developed airdrop hardware, toward accomplishing an aerial launch of the Minuteman I ICBM from a C-5A cargo aircraft The test objectives were to demonstrate the feasibility of an air mobile concept for standoff capability of strategic missiles and to provide empirical data for further derivations and assessments on aircraft response and stability, missile trajectories, and various subsystem performance, Specific identification and ranking of risk and problem areas regarding extraction, aircraft to missile separation, and missile stability become material contributions to deployment concept formulation for the M-X ICBM The overall test effort involved analysis of airdrop technology and assessment of system interface areas related to ground loading requirements, flight safety, and the missile air launch (Author)

A75-39496 # **Parallelism in commercial and military use of simulation** R D McLure (American Airlines, Inc , Fort Worth, Tex) and H A Kottmann (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-971* 11 p

The paper addresses the Commercial Airline and Military utilization of simulation systems in initial and continuation pilot training The paper will also briefly explore the technology and philosophy associated with growth and the utilization of simulation The specific topic will be the relationship of the growth of simulator utilization and reduction in flight training hours, the investment cost and cost savings, and the period of time involved The Commercial Airline portion will emphasize the use of the Systems Approach to training The Military portion will emphasize combat simulation stressing such programs as the Simulator for Air-to-Air Combat (SAAC) and the Advanced Simulator for Undergraduate Pilot Training (ASUPT) The portion dealing with the Commercial Airline will stress what has been achieved by the Airlines while the Military portion will define the potential increased use of simulation by the Air Force (Author)

A75-39500 # **In-flight simulation of the light weight fighters** G W Hall and R P Harper, Jr (Calspan Corp , Buffalo, N Y) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-985* 8 p USAF-supported research

The USAF/Calspan variable stability NT-33A airplane was used to simulate both the General Dynamics YF-16 and the Northrop YF-17 Light Weight Fighter prototypes prior to their first flights The YF-16 in-flight simulation showed that the side stick control system would be too sensitive with the original control gearings This conclusion was borne out in the early flight test phase when reduced control system gearings were incorporated in the YF 16 The YF 17 in-flight simulation showed degraded handling qualities in the landing approach due to low frequency control system roots in the longitudinal Control Augmentation System Control system modifications were proposed, implemented and evaluated in the NT 33A and a much improved longitudinal control system was incorporated in the YF-17 prior to its first flight The two simulation programs clearly demonstrate the advantages to be gained through use of in-flight simulation for engineering design and pilot training or familiarization (Author)

A75-39501 # **Northrop YF-17 ground testing and simulation** J T Gallagher and R Merriman (Northrop Corp , Hawthorne, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-986* 6 p

The Flight Control Test Stand (FCTS) is one of the engineering tools used in the flight control system development of the Northrop YF-17 airplane The FCTS is a functional simulator of the airplane involving mechanical, hydraulic, electrical and electronic systems The systems are the same as those used on the airplane In its fundamental mode the FCTS is used to qualify and life test the flight control system In its ancillary mode it is used as a fixed base simulator to investigate flight control system performance and as a test bed for control system modifications This paper describes the FCTS and its use in the testing and qualification of the YF-17 flight control system The application of the FCTS in the system development of the Control Augmentation System and in particular the failure management system is discussed Examples are presented of the supporting role played by the FCTS during the flight test development of the YF-17 prototype airplane (Author)

A75-39502 * # **Ride-quality testing under controlled flight conditions** W E Schoonover, Jr (NASA, Langley Research Center,

Hampton, Va) and J Dittenhauser (Calspan Corp , Buffalo, N Y) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-987* 10 p 6 refs

As part of a NASA program to develop the technology of ride quality, a flight test program has been conducted to obtain subjective reactions of a significant number of test passengers to a variety of controlled and repeatable flight conditions For these experiments, the computer of a variable-stability research aircraft was programmed to precisely control the aircraft's in-flight motions as specified by motion command signals prerecorded on magnetic tape Problems initially encountered derived primarily from the quality of the motion command signals and tape playback device, plus the aircraft motion response in degrees of freedom other than that desired Problem solutions were obtained through the use of filtering and compensating networks The variable-stability-system modifications, problems encountered, and their solutions are described The test procedure is described and sample results are presented which illustrate the usefulness of this technique for ride-quality research (Author)

A75-39503 # **Northrop/United States Air Force F-5E Aircraft Fatigue Structural Integrity Program** S R Murnane (Northrop Corp , Hawthorne, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75 988* 7 p

A comprehensive fatigue test program relative to the airframe structure of the Northrop F-5E air superiority fighter is described The primary objectives of the program are to locate critical areas, realize early improvements at relatively low cost, and to develop scheduled inspection and modification procedures that would minimize unscheduled structural maintenance The fatigue program is discussed as to load spectra and loading sequence development, a complete airframe flight by-flight fatigue test, and a counting accelerometer/service loads recording program Test results indicate that the primary airframe components meet all strength requirements so that the F-5E aircraft is able to meet and surpass the original design objectives of the aircraft structural integrity program S D

A75-39504 # **The C-5A active load alleviation system** T E Disney (Lockheed-Georgia Co , Marietta, Ga) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-991* 9 p 13 refs

Several forms of wing load reduction systems have been investigated for use on the C 5A for the purpose of reducing static loads and/or improving the fatigue life of the wing A fully active maneuver and gust load reduction system has been developed and flight tested and will be incorporated on the C-5A force beginning in late 1975 This system was developed for the specific purpose of providing a significant wing fatigue life improvement through reduction of maneuver and gust induced incremental wing bending moments This paper reviews the evolution of the present load alleviation system designated as ALDCS for Active Lift Distribution Control System and presents a brief description of the system and a simplified functional block diagram Comparisons of analytical and flight test measured maneuver and continuous turbulence loads are shown The effects of loads changes on fatigue damage rate predictions are discussed with particular emphasis on the implications of multiple load component changes, i e , reduced bending moments and increased torsional moments (Author)

A75-39505 * # **Augmentation of vortex lift by spanwise blowing** J F Campbell (NASA, Langley Research Center, Subsonic Transonic Aerodynamics Div , Hampton, Va) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-993* 10 p 19 refs

An investigation has been conducted to evaluate the aerodynamic effects associated with blowing a jet spanwise over a wing's upper surface in a direction parallel to the leading edge Experimental pressure and force data were obtained on wings with sweep angles of 30 and 45 degrees and showed that spanwise blowing aids in the formation and control of the leading-edge vortex and, hence, significantly improves the aerodynamic characteristics at high angles of attack Full vortex section lift is achieved at the inboard span station with a small blowing rate, but successively higher blowing rates are necessary to attain the full vortex-lift level at increased span distances Spanwise blowing generates large increases in lift at high angles of attack, improves the drag polars, and extends the linear pitching moment to high lifts (Author)

A75-39506 # **A large-scale low-speed tunnel test of a canard configuration with spanwise blowing** M W M Jenkins and R T Meyer (Lockheed Georgia Co , Marietta, Ga) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-994* 10 p Research supported by the Lockheed-Georgia Independent Development Funds

A half scale, modified JetStar, semi-span model was tested in a low speed wind tunnel Two different size canards were tested at two positions on the fuselage Spanwise blowing on the canards was varied over a nozzle blowing coefficient range from 0 to 1 0 Lift, drag, pitching and rolling moments were recorded during approximately 80 hours of testing A favorable total lift interference was measured for both canard positions with the aft, large canard exhibiting the larger values Stall angles of the complete model were increased up to 10 deg Significant nose-up pitching moments result from the canard lift at angles of attack below wing-alone stall Above wing-alone stall, the pitching moment remained essentially constant (Author)

A75-39507 * # **Effects of wing bend on the aerodynamic characteristics of a low aspect ratio oblique wing** E J Hopkins (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4 7, 1975, Paper 75-995* 6 p 10 refs

Static longitudinal and lateral/directional force and moment results are presented for an elliptical oblique wing (aspect ratio 6) mounted on top of a body of revolution The wing was tested at various sweep angles ranging from 0 to 60 deg throughout a Mach number range of 0 6 to 1 4 Increasing the upward bend along the wing span resulted in no significant improvement in the linearity of the moment curves, but required an impractical wing pivot location to eliminate the rolling moments at low lift Linear theory gave satisfactory predictions of the lift and moment-curve slopes at low lift (Author)

A75-39508 * # **Estimation of transonic aircraft aerodynamics to high angles of attack.** J A Axelson (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-996* 10 p 23 refs

A recently developed method for estimating transonic aircraft aerodynamics to high angles of attack which is especially suited to computerized aircraft design and optimization studies is described Following theoretical and empirical guidelines, explicit nonlinear equations are formulated for subsonic, transonic, and supersonic speeds, new algorithms are used for assessing compressibility effects and for analyzing transonic, shock-dominated flows which adhere to Laitone's limit Mach-number criterion Viscous dominated flows are not analyzed The transonic influence of viscosity is indirectly accommodated by assigning designated inputs rather than extracted solutions for the chordwise locations of shock and separation The method is extended to complete aircraft configurations by including accounts for nose lift, the wing downwash field, and tail lift Several comparisons of experiment and estimate are included (Author)

A75-39509 # **Composites technology - Threshold to low cost aircraft structures** F Cherry (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1006* 12 p 6 refs

The use of composite materials in aircraft structural applications to provide a lightweight airframe have been demonstrated in numerous engineering studies and development programs Numerous successful commitments have been made to utilize composite materials on production aircraft such as the F-14, F-15, and F 16 Because of the high cost of composite materials these commitments were limited to the high weight sensitivity areas of these aircraft principally the empennage structure The broader acceptance of composite materials will depend on lowering production cost and successful service experience Programs to develop low cost composite structures are underway and the composites applications on the F 14 and F-15 are now in service and performing adequately These programs, to develop low cost composite structures, will be described and current status will be reviewed (Author)

A75-39511 # **Divergence elimination with advanced composites** N J Krone, Jr (USAF, Systems Command, Andrews AFB, Md) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1009* 7 p 5 refs

The use of swept-forward airfoils has generally been ruled out due to the aeroelastic phenomenon known as divergence With the advent of advanced composite materials, a new capability (material tailoring) has been added to the structural field The purpose of this paper is to demonstrate that by tailoring the composite material properly, the structural weight penalty normally associated with divergence prevention can be greatly reduced To accomplish this a comparison is made of wing designs of various sweep angles The minimum weight for each sweep angle is determined through an optimization procedure (Author)

A75-39513 # **High-performance jet-V/STOL development** J E Waesche and D Midgal (Grumman Aerospace Corp , Advanced Systems Technology Div , Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1013* 12 p 14 refs

Dispersed force requirements for future Naval and land forces have led to studies of V/STOL aircraft with marked speed and payload advantages over the Harrier These studies indicate that, for strike/fighter missions, the lightest weight and lowest cost aircraft is one powered by a lift/cruise propulsion system, properly sized for high-speed missions, supplemented by a high-thrust/weight ratio lift-producing device (e g , lift engine) This type of aircraft introduces challenging design problems Some of Grumman's recent technology developments aimed at solving these problems are discussed in the key areas of aircraft/propulsion design, V/STOL aerodynamics, hot-gas effects, and control concepts (Author)

A75-39514 # **Analysis of response requirements for V/STOL lift/cruise engines used to provide height and moment control** J W Clark, Jr (U S Naval Material Command, Naval Air Development Center, Warminster, Pa) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1014* 12 p 6 refs Navy Task A3303300/001C/

This paper describes a parametric investigation which was performed to determine what constraints, if any, are imposed by handling qualities requirements on a V/STOL lift/cruise propulsion system when it is used to provide vehicle moment control Primary emphasis was placed on defining the magnitude of engine response time and incremental thrust necessary to satisfy the applicable requirements of the V/STOL Flying Qualities Specification, MIL-F-83300 A general lift plus lift/cruise configuration in the 30,000 pound gross weight class was used as the baseline aircraft model in the analysis Effect of nozzle location, relative proportion of lift and lift/cruise engine control power, control sensitivity, auxiliary reaction control system (RCS) power, and basic control system mode were evaluated (Author)

A75-39515 # **Aircraft altitude emissions - Fundamental concepts and future R & D requirements** W S Blazowski (USAF, Aero-Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1017* 20 p 47 refs

Recently announced findings of the Climatic Impact Assessment Program recommend an accelerated combustion research effort aimed at substantial reductions in aircraft NOx emission This paper is intended to summarize current understanding of pollutant formation fundamentals and to identify areas where further efforts are required The roles of chemical kinetics, gas dynamics, and turbulence are discussed along with their relationship to burner design characteristics Influences of these fundamental processes on emission characteristics and combustor control concepts are briefly reviewed Fundamental topics which require further investigation and necessary exploratory development tasks are identified New concepts such as catalytic combustion are also found to require much study, but seem to hold the greatest promise for very significant NOx reduction (Author)

A75-39516 * # **Jet aircraft emissions during cruise - Present and future** J S Grobman (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1018* 12 p 17 refs

Forecasts of engine exhaust emissions that may be practicably achievable for future commercial aircraft operating at high altitude cruise conditions are compared to cruise emissions for present day aircraft These results summarize jet aircraft emissions studies reported in the Climatic Impact Assessment Program (CIAP) Monograph 2 'Propulsion Effluents in the Stratosphere' The forecasts are based on (1) knowledge of emission characteristics of combustors and augmentors, (2) combustion research in emission reduction technology, and (3) trends in projected engine designs for advanced subsonic or supersonic commercial aircraft Recent progress that has been made in the evolution of emissions reduction technology will be discussed (Author)

A75-39520 # **Flutter investigations on a combat aircraft with a command and stability augmentation system** A Lotze, O Sensburg, and M Kuhn (Messerschmitt-Bolkow Blohm GmbH, Munich, West Germany) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1025* 13 p 14 refs

An analytical approach to the avoidance of instabilities in a sweepable-wing combat aircraft by means of an improved control system is presented Based on a ground resonance survey, the elastic structure of the craft is described by no mal modes, results of open- and closed-loop calculations are given in Nyquist and common flutter plots and compared with flight test data S J M

A75-39522 # **YC-14 flight control** A H Lee (Boeing Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1027* 11 p 8 refs

The YC-14 is the Boeing entry in the USAF Advanced Medium STOL Transport (AMST) program The task of operating a large jet aircraft into and out of a semi prepared, 2,000 feet long airstrip with a 27,000 pound payload presents an unusual flight control challenge The YC-14 answers this challenge using an advanced flight control system that includes digital computers Excellent STOL flying qualities have been achieved through control wheel steering and speed hold modes Fail operational, fail safe performance is provided

by a triplex flight control system Aircraft dynamics following an engine failure are docile and do not require immediate pilot attention or unusual skill The superior capability of digital computers to perform logic functions enables a comprehensive, semi-automated, preflight test Failures are detected and identified to the Line Replaceable Unit (LRU) The YC-14's use of redundant digital computers in the flight control role is a first for an aircraft designed to demonstrate operational use (Author)

A75-39523 # **Lateral-directional stability augmentation methods for the STOL flight regime** A Campbell and M Abramovitz (Douglas Aircraft Co , Long Beach, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1028* 6 p

A yaw axis augmentation system based on sideslip angle and sideslip angle rate is shown to provide superior characteristics for STOL operations when compared to a conventional yaw rate damper, turn coordination system This type of rudder augmentation system when operated in conjunction with an attitude command/attitude hold system in the roll axis can provide substantial suppression of aircraft motion transients in engine failure situations A method is proposed for mechanizing a 'Beta Command' configuration which will allow the pilot to execute a STOL type approach in crosswind conditions with reduced workload and improved precision (Author)

A75-39524 * # **Application of active control technology to aircraft ride smoothing** I D Jacobson and M Lapins (Virginia, University, Charlottesville, Va) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1029* 10 p 5 refs Grant No NGR-47-005-202

Prototype Ride Smoothing System (RSSs) were synthesized for flight testing aboard the National Aeronautics and Space Administration General Purpose Airborne Simulator (GPAS) The systems were designed to meet comprehensive criteria including passenger comfort and aircraft handling qualities considerations System performance estimates based on analytic expressions were compared to estimates derived from digital calculations The effect of RSSs on pilot workload during ILS approach in turbulence was examined in a fixed-base simulator A limited number of flights were conducted to verify predicted RSS performance Results of these experiments indicate that RSSs reduce pilot workload and increase passenger comfort while maintaining handling qualities (Author)

A75-39526 # **F-15 flight flutter testing - Aircraft systems and test operations** D E Nash, H Katz, and W C Moody (McDonnell Aircraft Co , St Louis, Mo) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1031* 9 p

The F-15 flight flutter test aircraft and its operation are described The existing flight control system, with relatively minor modifications, was used to excite the aircraft modes of interest An aircraft instrumentation system was installed to measure aircraft response to this excitation These measured data were simultaneously recorded onboard and telemetered to the ground On-ground and in-flight test operations are discussed, including operational problems encountered and their solution (Author)

A75-39527 # **MRCA flight flutter testing** D K Potter (British Aircraft Corp , Ltd , Preston, Lancs , England) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1033* 6 p

Flight flutter testing of MRCA has been carried out at maximum wing sweep up to maximum achievable speed at minimum safe altitude, tests at higher Mach Numbers at altitude and at intermediate wing sweep angles are currently in hand The airborne test equipment, analysis technique and test procedures are described A brief description is given of intended flutter testing of external stores (Author)

A75-39528 # **Performance compatibility and flight testing of B-52 CCV systems** G E Hodges and J. R McKenzie (Boeing Co , Wichita, Kan) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1035* 11 p 10 refs Contract No F33615-71-C-1926

As active flight control technology is applied to the design of future aircraft, compatibility and flight testing of multiple CCV systems becomes increasingly important. Compatibility of such systems has been successfully tested on a B-52 test airplane These systems are known as Control Configured Vehicles (CCV) systems A design and flight test program demonstrating the benefits of applying advanced flight control technology to large flexible airplanes was conducted by the Wichita Division of The Boeing Company under the sponsorship of the Air Force Flight Dynamics Laboratory Performance objectives of the B-52 CCV program were to extend the airplane flutter envelope, improve ride, reduce wing root bending moment during maneuvers, provide adequate flying qualities for a reduced static stability configuration and demonstrate performance compatibility of all CCV systems This paper is limited to presenting the analysis, flight test results, and a comparison of flight test results to analysis, with multiple CCV systems operating Flight demonstration was a significant and necessary step in the acceptance of multiple CCV concepts for incorporation into future aircraft design (Author)

A75-39529 * # **Design study of structural concepts for an arrow-wing supersonic-cruise aircraft** I F Sakata, G W Davis (Lockheed-California Co , Brubank, Calif), J C Robinson, and E C Yates, Jr (NASA, Langley Research Center, Hampton, Va) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1037* 13 p Contract No NAS1-12288

An analytical study was performed to determine the best structural approach for design of primary wing and fuselage structure of a Mach number 2 7 arrow-wing supersonic cruise aircraft Concepts were evaluated considering near-term start-of-design Emphasis was placed on the complex interactions between thermal stress, static aeroelasticity, flutter, fatigue and fail-safe design, static and dynamic loads, and the effects of variations in structural arrangements, concepts and materials on these interactions Results indicate that a hybrid wing structure incorporating low-profile convex beaded and honeycomb sandwich surface panels of titanium alloy 6Al-4V were the most efficient The substructure includes titanium alloy spar caps reinforced with Boron-polyimide composites The fuselage shell is a closed-hat stiffened skin and frame construction of titanium alloy 6Al-4V This paper presents an executive summary of the study effort, and includes a discussion of the overall study logic, design philosophy and interaction between the analytical methods for supersonic cruise aircraft design (Author)

A75-39530 * # **Application of an advanced computerized structural design system to an arrow-wing supersonic cruise aircraft** J C. Robinson, E C Yates, Jr (NASA, Langley Research Center, Hampton, Va), M J Turner, and D L Grande (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1038* 12 p 19 refs

A structural design study of an arrow-wing supersonic cruise aircraft has been made using the integrated design system, ATLAS, and a relatively large analytical finite-element model containing 8500 degrees of freedom This paper focuses on structural design methods developed and used in support of the study with emphasis on aeroelasticity The use of ATLAS permitted (1) automatic resizing of the wing structure for multiple load conditions, (2) rapid evaluation of aeroelastic effects, and (3) an iterative approach to the correction of flutter deficiencies The significant results of the study are discussed along with the advantages derived from the use of an advanced structural design system in preliminary design studies (Author)

A75-39531 * # **Joint USAF/NASA hypersonic research aircraft study** F S Kirkham, R A Jones (NASA, Langley Research Center, Hampton, Va), M L Buck, and W P Zima (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1039* 10 p

A joint USAF/NASA study has developed a conceptual design for a new high speed research airplane (X-24C) and identified candidate flight research experiments in the Mach 3 to 6 speed range Four major categories of high priority research experiments are described as well as the X-24C design concept The vehicle, a rocket-boosted, delta planform aircraft, is air launched from a B-52 and is capable of forty seconds of rocket cruise at Mach 6 with a research scramjet Research provisions include a dedicated 10-foot long research experiments section, removable fins and strakes, and provisions for testing integrated airbreathing propulsion systems (Author)

A75-39532 # **Propulsion system configuration development for the B-1 strategic bomber** L L Christensen (Rockwell International Corp , Los Angeles, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1040* 12 p

Penetration to targets can be accomplished two ways with the B-1 extremely low altitude at nearly the speed of sound, or high altitude at supersonic speeds This multimission requirement was a major factor in determining its engine size and selecting its air induction system arrangement Other factors included long subsonic and supersonic range and short takeoff distance Based on these requirements, design trade studies were performed for selecting and sizing the propulsion system elements The propulsion system consists of two under-wing dual nacelles, each containing two GE F101 augmented turbofan engines Individual external compression inlets with variable geometry were selected, along with convergent-divergent, variable-area exhaust nozzles Midway in the program, the inlet was changed from a mixed-compression to an all-external-compression type The wind tunnel development program for the inlet and the nozzle-afterbody has been completed and is summarized The effect of the installation losses on specific fuel consumption (SFC) is shown for representative subsonic and supersonic conditions (Author)

A75-39533 # **F-15 propulsion system design and development** H Sams (McDonnell Aircraft Co , St Louis, Mo) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1042* 12 p 8 refs

Considerations leading to the design and development of the highly-efficient propulsion system for the Air Force F-15 are reviewed in this paper These considerations involved the inlet, engine, and nozzle/afterbody and their mutual interactions and integrated system performance The propulsion system elements were systematically analyzed, designed, and developed to achieve high performance Trade studies were conducted to select the inlet design, the engine cycle, and the nozzle/afterbody configuration Integration of these elements into a total propulsion system/airframe was guided by data from extensive analyses and wind tunnel tests As additional wind tunnel, ground, and flight test data became available, design refinements were made to the inlet, engine and nozzle/afterbody (Author)

A75-39539 # **F-15 propulsion flight testing experience** E I Staley (McDonnell Aircraft Co , St Louis, Mo) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-1052* 10 p

The flight test program to develop the F100 engine and F-15 inlet system is presented The techniques to define the engine operating envelopes including airstarts, engine handling and afterburner handling are described The method utilized to test the two-dimensional, variable capture area engine inlet duct system is described To accomplish the goals of the flight test program, unique instrumentation and test articles were manufactured These items are described and their impact on the flight test program is evaluated The flight test program presented herein successfully accomplished all the goals envisioned at its inception within a very limited time period (Author)

A75-39824 **Probabilistic design and structural fatigue** F H Hooke (Department of Supply, Aeronautical Research Laboratories, Melbourne, Australia) *Aeronautical Journal,* vol 79, June 1975, p 267-273 10 refs

Aspects concerning the general problem of random loading and random strength are considered along with the characteristics of the aircraft structural loading envelope and questions regarding the design of a structure of well-balanced strength In cases in which the detection of the onset of fatigue failure in a structure is not possible, a safe working life is predicted from a knowledge of the intended load history and from the results of life tests on other structures Attention is also given to the case of the fail-safe or inspectable structure G R

A75-39857 # **Downwash during supersonic flow about a plate (Skos potoka pri sverkhzvukovom obtekanii plastiny)** T I Ovchinnikova and R M Golubitskaia *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia,* Apr 1975, p 104-109 In Russian

The deflection angle of a supersonic flow about a plate is determined from the pressure-equilibrium condition along the slip line as a function of the Mach number of the oncoming stream and the angle of attack Flow perturbations are presented in the form of expansion series through the velocity pitch angle in relation to the direction of the unperturbed flow It is shown that the deflection angle of a supersonic stream behind the trailing edge of a plate for small angles of attack is proportional to the cube of the angle of attack F G M

A75-39923 **Is there an airship in your future** J F Vittek, Jr (MIT, Cambridge, Mass) *Technology Review,* vol 77, July-Aug 1975, p 23-29

The possibilities for a reemergence of airships in the transportation systems of the future are examined, taking into account special advantages which airships could offer, economic factors, and certain operational difficulties It is found that for a number of applications a use of airship might very well have economic advantages compared to an employment of other means of transportation An actual prediction of the cost of airship service cannot be provided because of the absence of actual operational cost data It is concluded that at the moment the chances for a rebirth of the airship are not very good because of the risk which is inherent in an investment related to the establishment of an airship transportation system G R

A75-39981 # **The structure of high-pressure jets of low density issuing from a supersonic nozzle (O strukture vysokonapornykh strui nizkoi plotnosti za sverkhzvukovym soplom)** N I Kisliakov, A K Rebrov, and R G Sharafutdinov *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Mar-Apr 1975, p 42-52 21 refs In Russian

Experimental study of the structure of N2 and CO2 jets for a wide range of nozzle exit to ambient pressure ratios and Reynolds numbers A low-density gasdynamic apparatus with combined booster and cryogenic vacuum pumps was used in the experiments The study of the low-density jets was based on density measurements and visualization of the flow diagram with the aid of an electron beam The following regimes were studied (1) variable pressure ratio at constant CO2 flow rate, (2) variable CO2 flow rate at constant pressure ratio, and (3) N2 experiments at constant values of the complex Re characterizing the effect of viscosity in all jet regions The effect of condensation was studied for both N2 and CO2 flows, while the effect of temperature was studied in the N2 jet only Jet structure in the Mach disk region and in the X-shaped configuration was investigated P T H

A75-40174 # **Operational reliability of aircraft wheels (Ekspluatatsionnaia nadezhnost' aviatsionnykh koles)** I I Khazanov, R V Sakach, Ia N Peiko, S S Kokonin, and V V Mozalev Moscow, Izdatel'stvo Transport, 1974 224 p 73 refs In Russian

The present work discusses the major aspects of reliability of aircraft wheels in service The main design features of landing devices (undercarriages, wheels, and brakes) of Soviet and foreign construction are described The characteristics of current pneumatic tires for use in reliable service are examined The load capacity of aircraft wheels is discussed along with means of enhancing lifetime and reliability as a result of mechanical strengthening Maintenance and control techniques based on actual condition of wheels in service are described Improvement of brake units and aircraft deceleration during landing run are evaluated S D

A75-40175 # **The BSU-ZP onboard control system (Bortovaia sistema upravleniia BSU-ZP)** N M Savchenko and N P Annenkov Moscow, Izdatel'stvo Transport, 1974 244 p In Russian

The book reviews principles in the analysis of an aircraft as a control object and gives detailed descriptions of the operation, and design of several aircraft navigation and landing systems These include an onboard system for control of landing approach (the BSU-ZP), a computer-aided pilot-navigational system for assisting center-of-gravity stabilization and guiding along a preset path, an electronic autopilot for stabilization of aircraft angular coordinates relative to the center of mass, and an automatic trimming system Special consideration is given to a monitoring system that prevents the aircraft from entering a dangerous flight regime during failure of the BSU-ZP system by automatically switching off the defective channel and giving the pilot a signal P T H

A75-40194 # **Gyroscopes /2nd revised and enlarged edition/ (Giroskopy /2nd revised and enlarged edition/)** Ia N Roitenberg Moscow, Izdatel'stvo Nauka, 1975 592 p 140 refs In Russian

The book deals with theoretical aspects of gyroscopic instruments and devices used in airplanes, ships, and other moving objects Theories are presented for gyroscopic verticals, gyrocompasses, force and direct gyrostabilizers, and stabilized gyroplatforms Techniques of dynamic-systems optimization are examined in detail together with the motion of systems under the influence of random forces Analyses are conducted for optimum phase-state estimation, the optimum filtration techniques of Kolmogorov (1941) and Wiener (1950), the theory of optimum Kalman-Bucy filters, and optimum control by systems described with stochastic differential and difference equations F G M

A75-40198 # *Design of aircraft fuel systems (Proektirovanie* **toplivnykh sistem samoletov)** L B Leshchiner and I E Ul'ianov Moscow, Izdatel'stvo Mashinostroenie, 1975 350 p 37 refs In Russian

The present work is concerned with the fundamentals of the design of aircraft fuel systems (AFS) - Typical systems are examined, and effective design techniques are described for fuel feed systems, fuel transfer to service tanks, fuel tank pressurization, on-ground and in-flight fueling, and fuel tank drainage AFS design features are discussed both on the basis of their structural and functional relations to other systems in an aircraft and according to the influence of AFS on the aerodynamic, strength, and performance characteristics of various types of aircraft Also discussed are the properties of fuel systems at low and high temperatures and the control instrumentation of fuel systems S D

A75-40200 **The convention on international combined transport of goods - A new start also with regard to air transport (Das Uebereinkommen uber den internationalen kombinierten Guterverkehr - Ein neuer Anlauf auch im Hinblick auf die Luftbeforderung)** R Ganten *Zeitschrift fur Luft- und Weltraumrecht,* vol 24, June 1975, p 116-122 20 refs In German

A draft concerning a convention on international combined transport of goods as a basis for the discussions of the world container conference in 1972 had been submitted to the United Nations in November 1971 However, the draft was not discussed because of the diverging interests of the involved parties It was decided to write a new draft after a thorough study of the various aspects related to the combined transport of goods The legal questions and economic factors which will have to be considered in a convention on international combined transport of goods are discussed, giving attention also to objections which have been raised against the inclusion of air traffic in the agreement G R

A75-40206 **Measurements in an incompressible three-dimensional turbulent boundary layer, under infinite swept-wing conditions, and comparison with theory** B van den Berg, A Elsenaar, J P F Lindhout (National Aerospace Laboratory, Amsterdam, Netherlands), and P Wesseling (Technische Hogeschool Twente, Enschede, Netherlands) *Journal of Fluid Mechanics,* vol 70, July 15, 1975, p 127-148 31 refs Research supported by the Royal Netherlands Air Force and National Agency for Aerospace Programs

First a three-dimensional turbulent boundary-layer experiment is described An infinite swept-wing flow has been simulated with good accuracy The initially two-dimensional boundary layer on the test plate was subjected to an adverse pressure gradient, which led to three-dimensional separation near the trailing edge of the plate Next, a calculation method for three-dimensional turbulent boundary layers is discussed This solves the boundary-layer equations numerically by finite differences The turbulent shear stress is obtained from a generalized version of Bradshaw's two-dimensional turbulent shear stress equation The results of the calculations are compared with those of the experiment Agreement is good over a considerable distance, but large discrepancies are apparent near the separation line (Author)

A75-40254 # **Calculation of supersonic inviscid flow about a pyramidal-body model of a delta-shaped vehicle (Raschet sverkhzvukovogo neviazkogo techeniia u piramidal'nogo tela, modeliruiushchego del'tovidnyi letatel'nyi apparat)** A P Kosykh and A N Minailos *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* May-June 1975, p 105-111 21 refs In Russian

The flow and weight characteristics of a trihedral pyramid, flying with supersonic speed at an angle of attack are investigated using a nonlinear method of direct calculation A three-dimensional stationary analog of a finite-difference scheme of direct calculation is developed and applied in a Cartesian system of coordinates X,Y,Z The form of the body is specified in terms of analytic functions Its surface elements are approximated by planar components using the method of least squares The planes cut several nonstandard volumes in the cells of the grid, and these volumes are used in the calculation together with standard cells having the form of parallelepipeds and not adjoining the body surface M G

A75-40255 # **Numerical investigation of the flow of a viscous, heat-conducting gas past a blunt body with finite dimensions (Chislennoe issledovanie techeniia viazkogo teploprovodnogo gaza i tupogo tela konechnykh razmerov)** A V Babakov, O M Belotserkovskii, and L I Severinov *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* May-June 1975, p 112-123 12 refs In Russian

Study of the flow of a viscous, heat-conducting gas past a sphere, at large freestream hypersonic Mach numbers and moderate freestream Reynolds numbers, when the influence of viscosity is substantial in the entire disturbed region and the gas flow is laminar The force and heat effects of the flow on the body are calculated, and the characteristics of the gas flow near the base region of the body are studied in detail The influence of the Reynolds number on the sphere's drag and on the drag of the base region is shown in addition to the distribution of local friction and pressure in the base region M G

A75-40259 # **Parabolic method for solving the problem of a sonic gas flow about a thin symmetric profile (O parabolicheskom metode reshenila zadachi obtekanila tonkogo simmetrichnogo profilia zvukovym potokom gaza)** V Iu Ol'shanskii and S V Fal'kovich *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* May-June 1975, p 168-171 8 refs In Russian

A75-40260 # **The problem of the optimal form of lifting bodies in Newtonian flow (K zadache ob optimal'noi forme nesushchikh tel v N'iutonovskom potoke)** E I Filatov *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* May-June 1975, p 171-174 In Russian

The upper and lower surfaces of a body having blunt leading edges and exhibiting maximum aerodynamic performance at hypersonic speed are investigated using the Ritz method The exact shapes of upper and lower surfaces are specified for maximum aerodynamic performance The drag of the leading edges is found not to have significant influence on the performance of optimum bodies M G

A75-40405 # **Remarks on approximate conformal representation of biplane wing sections** W J Prosnak (Warszawa, Politechnika, Warsaw, Poland) *Académie Polonaise des Sciences, Bulletin, Série des Sciences Techniques,* vol 23, no 2, 1975, p 7 (161)-19 (173) Research supported by the Instytut Lotnictwa

A normalization of a mapping function representing approximately a given biplane wing section is considered The normalization modifies the function in such a manner that after the modification, the leading and trailing edges of profiles of the approximate biplane wing section coincide with those of the profiles of the given biplane wing section Construction of a first approximation to the mapping function which fulfills this condition is presented The construction is based on two mapping functions, representing each of the profiles of a given biplane section separately Three numerical examples of such a first approximation are given (Author)

A75-40475 **F-16 - First with fly-by-wire** C E Wise *Machine Design,* vol 47, Aug 7, 1975, p 16-18, 20, 21

An American aerospace corporation has been selected by the Air Force to build the F 16 fighter aircraft The electronic equipment of the F-16 includes a fly-by wire (FBW) flight-control system An unstable aircraft design concept was adopted for the aircraft as a means to reduce drag Operational and design details of the FBW system are discussed along with questions related to the use of a side-stick controller in the aircraft G R

A75-40501 * **Challenges of short-haul air transportation** T L Galloway (NASA, Ames Research Center, Moffett, Field, Calif) and J A Stern (Douglas Aircraft Co , Long Beach, Calif) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750586* 17 p NASA supported research

Short-haul transportation systems are characterized by low average utilization, high peak but low average passenger demand, severe competition from other transportation modes, high fixed costs and high operating costs Studies were conducted to analyze the operational requirements and market size for medium-density air transportation The determination of the aircraft that will most efficiently meet the requirements of this market requires the careful evaluation of variable parameters such as engine cycles, payload, field length range and type of high-lift system Low noise, low cost and thrust reversing capability are the basic criteria for the propulsion system It is concluded that aircraft of less than 50-seat capacity cannot generate satisfactory profits operating in the medium density market M G

A75-40502 * **Design of short haul aircraft for fuel conservation** M K Bowden, H S Sweet (Lockheed Georgia Co , Marietta, Ga), and M H Waters (NASA, Ames Research Center, Moffett Field, Calif) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750587* 16 p 6 refs

Current jet fuel prices of twice the 1972 level have significantly changed the characteristics of airplane design for best economy The results of a contract with the NASA Ames Advanced Concepts and Missions Division confirmed the economic desirability of lower design cruise speeds and higher aspect ratio wings compared to designs developed in the by-gone era of low fuel price Evaluation of potential fuel conservation for short-haul aircraft showed that an interaction of airfoil technology and desirable engine characteristics is important the supercritical airfoil permits higher aspect ratio wings with lower sweep, these, in turn, lower the cruise thrust requirements so that engines with higher bypass ratios are better matched in terms of lapse rate, lower cruise speeds (which are also better for fuel and operating cost economy) push the desired bypass ratio up further Thus, if fuel prices remain high, or rise further, striking reductions in community noise level can be achieved as a fallout in development of a 1980s airplane and engine Analyses are presented of developmental trends in the design of short-haul aircraft with lower cruise speeds and higher aspect ratio wings, and the effects on fuel consumption of design field length, powered lift concepts, and turboprop as well as turbofan propulsion are discussed (Author)

A75-40504 **Analysis of the costs, effectiveness, and benefits of aircraft noise reduction programs** H B Safeer (U S Department of Transportation, Washington, D C) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750595* 8 p

Studies were performed, of 23 U S airports, to analyze the costs, effectiveness, and benefits of a variety of alternative means of reducing the impact of aircraft noise, including retrofit of all JT3D and/or JT8D powered aircraft with new nacelles containing sound absorption material (SAM), modified take off and approach procedures, and acquisition of land within the NEF 40 contour The cost effectiveness analysis provided a relative ordering of the options in terms of number of people and land area removed from the NEF 30+ and 40+ areas for the aeronautical options The benefit cost analysis resulted in a determination of which options yielded at least a dollar's worth of benefit for the last dollar spent The analysis of total cost, including the cost of acquiring the residual land in the NEF 40+ area, resulted in a determination of the minimum total cost option M G

A75-40505 **10 years of STOL - The Twin Otter's first decade** M C W Davy and P S Martin (De Havilland Aircraft of Canada, Ltd , Downsview, Ontario, Canada) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750596* 8 p

The evolution of STOL as a means of public transport has been significantly affected by the aircraft Twin Otter and its performance during the ten years since its first flight on May 20, 1965 The success of the aircraft in the field of urban commuter service for a while overshadowed its performance as a bushplane for the Canadian north, although the aircraft had been originally designed as a replacement for the conventional bushplane The development of alternative landing gears and the exploitation of the aircraft's STOL performance made it then possible to use Twin Otter for operations at locations denied to conventional aircraft G R

A75-40506 **Short haul transportation - The helicopter's time is now** R F Daniell and R E Warren (United Aircraft Corp , Sikorsky Aircraft Div , Stratford, Conn) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750598* 10 p

An investigation concerning a utilization of the helicopter in short-haul transportation applications is considered Obstacles to short-haul V/STOL are examined It is concluded that the technology for building the required system has been available for years Obstacles which have prevented the establishment of the needed transport system are related to difficulties in financing the needed developments Specific uses of a new short-haul VTOL system are discussed G R

A75-40507 * NASA refan program status K L Abdalla and J A Yuska (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750592* 34 p 5 refs

The objective of the refan program is to demonstrate the technical feasibility of substantially reducing the noise levels of existing JT8D powered aircraft The program consists of the design, manufacturing and testing of the refan engines and modified nacelles and airplanes Experimental testing has been completed for the refan engine both at sea level and at altitude conditions Ground testing for the B727 side- and center-engine installations and flight testing of the DC-9 with refan engines and acoustic nacelles have been performed Analyses of the test results are in progress Preliminary results presented in this paper show that substantial noise reductions were achieved (Author)

A75-40508 Airtransit's first six months of operating the Canadian STOL demonstration service R B McCormack (Airtransit Canada, Montreal, Canada) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750599* 12 p

A complete STOL (Short Take-off and Landing) system is currently providing public transportation service between the urban centers of two large Canadian cities Passenger and public reaction, plus operating experience in a competitive environment is providing some interesting data, useful in developing future STOL systems as an important component in the improvement of transportation in general The Demonstration is showing that STOL systems are capable of quickly providing fast, convenient, short-haul service, while at the same time respecting the composite concerns of society, encompassing air pollution, noise, land-use, energy-consumption and economics (Author)

A75-40509 Whither all weather - An airline engineer's point of view O R Evans (United Air Lines, Inc , Chicago, Ill) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750600* 8 p 5 refs

A brief listing of major elements of the All Weather Landing System is presented The chronology of growth in the use of this system by a major trunk airline in the last decade is reviewed Problems considered by the author to be basic to further deployment and development of the system are discussed and tentative solutions to these problems are suggested, namely (1) Continuous recording and public dissemination of Runway Visual Range data for all Category II and III periods at existing and proposed runways of these Categories is suggested to provide the most cost-effective basis for decisions regarding further deployment of ILS systems and MLS systems (2) It is recommended that an industry group be convened to review and, probably, revise certification requirements for aircraft intended to operate below Category II minima in order to break the stalemate presently inhering in those activities (Author)

A75-40510 Whither all weather - An airplane manufacturer's point of view H N Tobie (Boeing Commercial Airplane Co , Renton, Wash) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750601* 6 p

Automatic landing has been developed to the point where all the wide-bodies jets have it as basic equipment The techniques presently employed are generally founded upon the technology of the last two decades - especially with respect to analog computation and gyroscope references Several new techniques are now available which can substantially improve the autoland systems for the next generation of transport aircraft These include airborne digital computers, the use of integrated air data and strapdown airplane motion reference systems, expanded use of automatic system test, and the development and employment of the Microwave Landing System (MLS) These new technology developments promise to provide expanded operational benefits, reduced maintenance, and increased availability over that of contemporary autoland systems (Author)

A75-40513 * Quiet clean short-haul experimental engine /QCSEE/ design rationale A P Adamson (General Electric Co , Fairfield, Conn) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750605* 11 p NASA-supported research

The principal design features of the NASA QCSEE Under-The-Wing and Over-The-Wing powered lift propulsion systems are given In the UTW engine, these include noise reduction features, a variable pitch low pressure ratio fan, a fan drive reduction gear, an advanced core and low pressure turbine with a low pollution combustor, a digital control, and advanced composite construction for the inlet, fan frame, fan exhaust duct, and variable area fan exhaust nozzle The OTW engine is similar but has higher fan pressure and a fixed pitch fan Both engines are scheduled to be fabricated and tested starting in 1976 (Author)

A75-40514 Installation effects on the CF6-50 in the YC-14 aircraft R K Tuten, F R Housley, and P J Hess (General Electric Co , Aircraft Engine Group, West Lynn, Mass) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750607* 15 p

Design of the YC-14 over-the-wing nacelle, utilizing the CF6-50D engines, presented unique engine installation conditions which have been accommodated with very minor impact to the baseline commercial engine design Major installation features which affect the engine are reviewed including engine mounting, engine/aircraft deflections and nacelle sealing, effect of the confluent-flow exhaust nozzle on engine cycle matching, and inlet/thrust reverser/engine compatibility Design solutions and planned testing to evaluate the installation are discussed (Author)

A75-40515 * Noise reduction of EBF propulsive-lift systems J S Gibson (Lockheed-Georgia Co , Marietta, Ga) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750608* 12 p Contract No NAS3-16831

In a recently completed program, static and wind tunnel measurements have been made of the basic noise, noise reduction, and performance characteristics of externally blown flap (EBF) propulsive-lift systems The static tests were performed on an outdoor model rig Noise evaluations were made for parameters such as basic system geometry, flap slot dimension variation, elimination of flap slots, sweep angle variation, passive flap trailing edge modifications, active (blowing) trailing edge modifications, and for an ejector/decayer exhaust system The wind tunnel evaluation determined forward speed effects on EBF systems noise characteristics The results from the experimental programs are discussed as to their application to full scale short haul aircraft (Author)

A75-40516 * Full-scale upper-surface-blown flap noise L J Heidelberg, L Homyak, and W L Jones (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750609* 28 p 9 refs

A highly noise-suppressed TF 34 engine was used to investigate the noise of several powered lift configurations involving upper-surface-blown (USB) flaps The configuration variables were nozzle type (i e slot and circular with deflector), flap chord-length, and flap angle The results of velocity surveys at both the nozzle exit and the flap trailing edge are used for correlation of the noise data Configurations using a long flap design were 4 dB quieter than a short flap typical of current trends in USB flap design The lower noise for the long flap is attributed primarily to the greater velocity decay of the jet at the flap trailing edge The full-scale data revealed substantially more quadrupole noise in the region near the deflected jet than observed in previous sub-scale tests (Author)

A75-40517 An overview of low medium density short-haul air transportation policy implementation F R Mazzitelli (Grumman Aerospace Corp , Bethpage, N Y) *Society of Automotive Engineers,*

Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750610 8 p 13 refs

A review is presented of the national transportation policy as it specifically affects the low and medium density short-haul air transportation system In 1971, the problem of providing air service to low density, short haul markets had been identified as the third most pressing difficulty the aviation industry faced (following noise and congestion) A low-density, short-haul program which included system concept studies and vehicle definition studies was initiated by DOT and NASA in 1972 to define technology and research goals G R

A75-40518 **The Spanloader advanced transport concept** R H Lange (Lockheed-Georgia Co , Marietta, Ga) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750616* 8 p 10 refs

The Spanloader design involves a thick, highly swept, constant-chord wing with a center body and T-tailed empennages attached at the wing tips Most of the cargo and fuel are stored in the wing structure in order to achieve a near-uniform distribution of internal loading to match external aerodynamic loads Advancements in technology utilized in the Spanloader concept are related to the NASA supercritical airfoil, the principle of lift augmentation for improved airport performance, the employment of advanced filamentary composite materials in the structure, and an air-cushion landing system G R

A75-40519 **Maximum installed engine utilization through disciplined health monitoring** H W Bart and A B Nadler (Swissair Transport Co , Ltd , Zurich Airport, Switzerland) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750612* 8 p

The engine monitoring system of a European airline is discussed, taking into account fundamental considerations regarding engine monitoring problems, economic aspects, reliability checks, and aspects of long term and short term engine monitoring Monitoring concepts and practical examples are considered, giving attention to shop supervision, a manual trend analysis, oil analyses, visual inspection, and vibration measurements G R

A75-40520 **Engine maintenance management program requires information** L C Ellis and R H Johnson (United Air Lines, Inc , Chicago, Ill) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750613* 6 p

A review is presented of the key information requirements and techniques employed in the maintenance program of an American airline The program contains the three primary maintenance processes of hard time (overhauls), on-condition sampling, and condition monitoring It is pointed out that the cornerstone of any maintenance/reliability program is an effective information col lection, analysis, and dissemination system Attention is given to current information systems and plans for an improved system G R

A75-40521 **Future hydrogen fueled commercial transports** A J K Carline (General Dynamics Corp , St Louis, Mo) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750615* 12 p 6 refs

An examination is conducted of the problems inherent in the design of future subsonic liquid hydrogen fueled transports Atten tion is also given to the economic aspects of subsonic commercial transports which use liquid hydrogen as fuel It is found that such transports are very competitive with equivalent jet fueled aircraft It is pointed out that all economical data are very dependent on the relative price of liquid hydrogen and jet fuel G R

A75-40522 **Advanced supersonic transport** R D FitzSimmons and R L Roensch (Douglas Aircraft Co , Long Beach, Calif) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750617* 9 p 8 refs

Comparisons are presented between the last U S SST design and results of recent progress on an advanced supersonic transport design The results are shown of changing from a double-delta 2 7 Mach configuration to a modified arrow-wing 2 2 Mach design Information is presented covering increased range, lower operating cost, reduced technical risk, and noise levels that meet anticipated requirements of society The main emphasis in this paper is on an aerodynamic lift-to-drag ratio of 10 and how this high level of aerodynamic cruise efficiency can be substantiated for a tailored design (Author)

A75-40523 **Future lighter-than-air concepts** J J Schneider (Boeing Vertol Co , Philadelphia, Pa) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750618* 12 p

This paper examines the lighter-than-air situation today, presents a historical overview of the airship, and discusses the possible uses for future airship concepts Technical and operational characteristics of conventional and hybrid concepts are discussed as well as results of a parametric analysis of advanced airship concepts Speed and cost trends of both conventional rigid and partially buoyant hybrid airship concepts are presented (Author)

A75-40524 **Design of jet engine rotors for long life** S A Sattar and J T Hill (United Aircraft Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750619* 12 p 6 refs

An overview is provided concerning the general considerations which have to be taken into account in the design of aircraft gas turbine engine disks Attention is given to factors assuring a long life, the vibration characteristics, and the dimensional growth limits of the rotor The criteria which have to be satisfied for an acceptable rotor design are related to acceptable dynamics, minimal dimensional changes, the prevention of rupture due to overspeed, and the prevention of failure by low cycle fatigue G R

A75-40530 * **Engine design considerations for 2nd generation supersonic transports** R A Howlett (United Aircraft Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750628* 16 p 7 refs NASA-sponsored research

The environmental and economic goals projected for advanced supersonic transports will require revolutionary improvements in propulsion systems Variable cycle engine concepts that incorporate unique components and advanced technologies show promise in meeting these goals Pratt & Whitney Aircraft is conducting conceptual design studies of variable cycle engine concepts under NASA sponsorship This paper reviews some of the design con siderations for these engine concepts Emphasis is placed on jet noise abatement, reduction of emissions, performance improvements, installation considerations, hot section characteristics and control system requirements Two representative variable cycle engine concepts that incorporate these basic design considerations are described (Author)

A75-40531 * **The NASA research program on propulsion for supersonic cruise aircraft** R J Weber (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750629* 8 p

Since 1972 NASA has pursued a program aimed at advancing the technology and establishing a data base appropriate for the possible future development of supersonic cruise aircraft This paper briefly reviews the objectives and status of the propulsion portion of the program Building upon a continuing series of propulsion system studies, research activities are under way in noise and pollution reduction, inlet stability, and materials (Author)

A75-40532 **Disc failures - A cause for concern** J Belson *Flight International*, vol 108, July 31, 1975, p 163-166

It is pointed out that disk design has been a problem since the introduction of the gas-turbine engine with its high-energy internal rotating components A disk fails about once every million aircraft hours Aspects of rotor disk design and manufacture are considered along with the inspection and production control techniques used Fatigue is the major factor affecting the service life of a disk Current airworthiness regulations are examined and details concerning the occurrence of disk failures are discussed Attention is also given to approaches for reducing the incidence of disk failures G R

A75-40550 # **Use of short period frequency requirements in horizontal tail sizing** D J Moorhouse and M W M Jenkins (Lockheed-Georgia Co , Marietta, Ga) *Journal of Aircraft*, vol 12, June 1975, p 560, 561

An approach is proposed for determining the aft center of gravity limit required to meet the flying qualities specification for short period dynamics The procedure does not necessarily guarantee acceptable flying characteristics However, the approach constitutes a rational method for calculating the aft center of gravity limit in the initial design phase of sizing the horizontal tail of a new aircraft configuration G R

A75-40593 # **Engineering calculations of gas turbine engines by the method of small deviations /3rd revised and enlarged edition/ (Inzhenernye raschety gazoturbinnykh dvigatelei metodom malykh otklonenii /3rd revised and enlarged edition/)** A Ia Cherkez Moscow, Izdatel'stvo Mashinostroenie, 1975 380 p 18 refs In Russian

The present work sets forth the principles of the method of small deviations in the design, testing, and final adjustment of gas turbine engines The method provides a unified manner of expressing changes in parameters or characteristics of various engine elements under their joint operation and mutual influence P T H

A75-40602 **747 air carriage of the Space Shuttle Orbiter** W G Register (Boeing Aerospace Co , Seattle, Wash) In Technology today for tomorrow, Proceedings of the Twelfth Space Congress, Cocoa Beach, Fla , April 9-11, 1975
Cocoa Beach, Fla , Canaveral Council of Technical Societies, 1975, p 1-1 to 1-11

The Space Shuttle system requires a means for transport of the Orbiter vehicles to the test and launch sites Evolutionary aspects of the program for air carriage of the Orbiter vehicle on the Boeing 747 aircraft are discussed The 747 air carry system provides the means for conducting Orbiter approach and landing tests at Edwards Air Force Base and the air ferry of the Orbiter to the vertical launch sites Technical and program aspects of the carrier aircraft modification to meet the requirements and objectives of the Space Shuttle Program are presented (Author)

A75-40833 **Pollution control in continuous combustion engines** A H Lefebvre (Cranfield Institute of Technology, Cranfield, Beds , England) In International Symposium on Combustion, 15th, Tokyo, Japan, August 25-31, 1974, Proceedings
Pittsburgh, Pa , Combustion Institute, 1975, p 1169-1179, Comments, p 1179, 1180 48 refs

It is shown that the development of low emission combustors is proceeding along two main lines The simplest and most direct approach is through various minor modifications to established hardware, e g , by changes in liner geometry and airflow distribution and by the adoption of more sophisticated methods of fuel injection These modifications may be supplemented, where feasible, by compressor air bleed at low power operation and water injection at high power conditions The other approach is towards radically new concepts which involve major combustor redesign Of these the most promising appear to be variable geometry and staged combustors, and also 'prevap/premix' systems in which the fuel is vaporized and thoroughly mixed with all the air required for combustion upstream of the combustion zone (Author)

A75-40860 # **Impact erosion - A serious environmental threat to aircraft and missiles** G F Schmitt, Jr (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) *ASME, SAE, AIAA, ASMA, and AIChE, Intersociety Conference on Environmental Systems, San Francisco, Calif , July 21-24, 1975, ASME Paper 75-ENAs-45* 11 p 5 refs Members, $1 00, nonmembers, $3 00

The mechanisms of erosion on various materials and the comparative behavior of them in rain and ice environments are discussed The influence of environmental parameters such as velocity, impingement angle and heating are also discussed Guidelines for improvement of materials for various applications have been determined based upon research which has been conducted The simulation facilities utilized for the research and assessment of materials capability are described Postulated erosion requirements for advanced systems are presented based upon naturally occurring environments, simulated conditions in various apparatus, and comparative behavior with existing materials The broad scope of the erosion problems encountered in aerospace systems has been indicated by the subjects touched on in this paper (Author)

A75-40891 # **The B-1 environmental control system** P G Stein (United Aircraft Corp , Hamilton Standard Div , Windsor Locks, Conn) and L Scheele (Rockwell International Corp , Los Angeles, Calif) *ASME, SAE, AIAA, ASMA, and AIChE, Intersociety Conference on Environmental Systems, San Francisco, Calif , July 21-24, 1975, ASME Paper 75-ENAs-13* 7 p Members, $1 00, nonmembers, $3 00

On December 23, 1974, the B-1 airplane started its flight test program with a 90-min flight from Palmdale, California A very important part of this multi-mission aircraft is the environmental control system (ECS) This system embodies a number of important advancements while retaining the basic advantages of present operational ECS systems Specific advantages include modular concepts, use of fuel heat sinks to reduce ECS dependence on engine bleed air, and improvements in operational reliability over present military ECS The paper presents the basic ECS concepts used on the B-1, the advantages of this system, and some of the design considerations included in the system The development program is discussed along with techniques utilized to permit early detection and correction of development problems prior to aircraft installation (Author)

A75-40894 # **A fluidically controlled aircraft environmental system** P S Evans (AiResearch Manufacturing Company of America, Phoenix, Ariz) and C D Campbell (AiResearch Manufacturing Company of California, Torrance, Calif) *ASME, SAE, AIAA, ASMA, and AIChE, Intersociety Conference on Environmental Systems, San Francisco, Calif , July 21-24, 1975, ASME Paper 75-ENAs-7* 9 p Members, $1 00, nonmembers, $3 00

A program entitled 'Fluidic Thermal Controls', was conducted for the United States Air Force The primary objective was to use fluidics technology to control the cabin temperature in a typical military fighter aircraft The fluidic components were to be used with state-of-the-art components to provide an integrated control system The major system components that were used, such as heat exchangers, water separator, and cooling turbine, were existing parts The program discussed included establishment of a system concept, concept analysis, fabrication of components, and testing The system was designed to utilize a minimum of mechanical parts, while flueric components were implemented for sensing, computation, and power output Linear approximations to system components were used for initial analysis during system buildup Successful testing of the system revealed that presently developed fluidic circuitry is capable of performing as required in environmental control system applications (Author)

A75-40896 # **Small gas turbine auxiliary power units** C Rodgers (International Harvester Co , San Diego, Calif) *ASME, SAE, AIAA, ASMA, and AIChE, Intersociety Conference on Environmental Systems, San Francisco, Calif , July 21-24, 1975, ASME Paper 75-ENAs-1* 22 p Members, $1 00, nonmembers, $3 00

Self sufficiency for small fighter aircraft operating from remote advanced bases can be attained with small on-board auxiliary power units (APUs) supplying pneumatic power to start the main engine and for the environmental control systems Various attributes of three candidate APU design configurations are discussed, one integral bleed and two with a separately driven high speed load compressor Detailed examination of the candidates reveals the overall superiority of the integral bleed APU in most aspects, except for overall diameter, confirming its predominant use in most aircraft equipped with APUs (Author)

A75-40903 # **Analytical design of a monolithic wing (Ob analiticheskom proektirovanii monolitnogo kryla)** M A Bogomol'nyi and T K Sirazetdinov *Aviatsionnaia Tekhnika,* vol 18, no 2, 1975, p 13-18 5 refs In Russian

The problem is discussed of designing a beveled monolithic wing of uniform cross section for such technical constraints as weight, displacements, stresses, etc The stiffness characteristics of the wing cross-sections are controlled by varying the size of the sectional cut-outs Numerical methods of solution are proposed, and the design of a minimum-weight wing for given stresses and deflections is demonstrated V P

A75-40905 # **Theory for calculating a wing of small aspect ratio from a discrete-continuous calculation scheme /matrix differential equation of axial displacements/ (Teoriia rascheta kryla malogo udlineniia po diskretno-kontinual'noi raschetnoi skheme /matrichnoe differentsial'noe uravnenie osevykh peremeshchenii/)** M B Vakhitov and N G Larionov *Aviatsionnaia Tekhnika,* vol 18, no 2, 1975, p 25-30 In Russian

A75-40910 # **Mathematical description of a wing surface (K matematicheskomu opisaniiu poverkhnosti kryla)** T V Koriaka *Aviatsionnaia Tekhnika,* vol 18, no 2, 1975, p 59-63 In Russian

A method is proposed for obtaining the mathematical model of a wing surface The problem of calculating the wing profile is reduced to the determination of the coordinates of intermediate points that are required to determine the external configuration of the wing The line of the wing profile is determined with the aid of a cubic parabola given in vector-parametric form Analytical relations describing the upper and the lower surface of the wing are derived V P

A75-40912 # **Solution of the inverse problem of the hypersonic gas flow past a slender blunted body (K resheniiu obratnoi zadachi obtekaniia tonkogo zatuplennogo tela giperzvukovym potokom gaza)** N M Monakhov *Aviatsionnaia Tekhnika,* vol 18, no 2, 1975, p 69-77 In Russian

The flow of an ideal gas past a wing with a blunt leading edge and past a blunted body of revolution is analyzed in the case where the shock waves are similar to those generated by a strong detonation (self similar motion at a blunted plate or a blunted cylinder) An exact similar solution is obtained, using the classical perturbation method in combination with the Poincare-Lighthill-Kuo method The equations derived describe the surface of the body situated in the flow and the density and pressure at this surface It is shown that the third approximation is sufficiently accurate even at small distances from the bluntness V P

A75-40913 # **Vortex method for calculating a wing profile of arbitrary shape (Vikhrevoi metod rascheta profilia liuboi formy)** Z Kh Nugmanov *Aviatsionnaia Tekhnika,* vol 18, no 2, 1975, p 78-83 9 refs In Russian

The potential flow of an ideal incompressible fluid at an angle of attack past an arbitrary wing profile with a sharp leading edge is analyzed The reduced velocity at the wing surface is determined, in series form, from the solution of a Fredholm integral equation of the second kind The series coefficients are obtained with the aid of the Bubnov-Galerkin method V P

A75-40917 # **'Snap-through' vibrations of the empennage (O kolebaniiakh 'proshchelkivaniia' opereniia)** V A Pavlov *Aviatsionnaia Tekhnika,* vol 18, no 2, 1975, p 99-105 6 refs In Russian

The vibrations of an empennage whose rudder moves on more than two hinges are analyzed The equations of motion are derived and are reduced to a system of two nonlinear differential equations It is shown that, in addition to resonance vibrations, rudder buffeting, and flutter, there may arise vibrations leading to snap-through of the rudder The conditions leading to snap-through are identified V P

A75-40918 # **Approximate method for calculating the aerodynamic characteristics of semicircular wings with a constant sweep span (Priblizhennyi metod rascheta aerodinamicheskikh kharakteristik polukol'tsevykh kryl'ev s postoiannoi po razmakhu strelovidnost'iu)** A I Pastukhov and G S Kudriavtsev *Aviatsionnaia Tekhnika,* vol 18, no 2, 1975, p 106-111 In Russian

A75-40922 # **Differential thrust equations for a transient mode of engine operation (Differentsial'nye uravneniia izmeneniia tiagi dvigatelia v neustanovivshemsia rezhime ego raboty)** G M Trakhtenberg *Aviatsionnaia Tekhnika,* vol 18, no 2, 1975, p 129-134 In Russian

A procedure is developed for deriving nonlinear differential equations describing the unsteady thrust of an aircraft engine on the basis of its experimental and design characteristics The equations proposed are useful in the solution of flight dynamics problems V P

A75-40931 # **Calculation of the aerodynamic characteristics of a rectangular wing with end washers near a screen (K raschetu aerodinamicheskikh kharakteristik priamougol'nogo kryla s kontsevymi shaibami vblizi ekrana)** S D Ermolenko, Iu A Rogozin, and G V Rogachev *Aviatsionnaia Tekhnika,* vol 18, no 2, 1975, p 168-171 In Russian

A75-40960 **Integrally stiffened graphite/epoxy construction** G C Krumweide (General Dynamics Corp , Convair Div , San Diego, Calif) In Technology in transition, Proceedings of the Twentieth National Symposium and Exhibition, San Diego, Calif , April 29-May 1, 1975 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1975, p 57-66

An advanced wingbox test specimen incorporating graphite/epoxy skins and an aluminum substructure was designed, fabricated, and tested Presented is a comprehensive discussion of the thermal-pressure-forming process used to produce the large, flat, integrally stiffened (cocured I-section stiffeners) skin panels for this wingbox In addition, the fabrication process for net-formed access doors, which are flush mounted to these skin panels, is described The low-cost implications of these fabrication processes, with respect to minimizing manufacturing cost, are also presented (Author)

A75-40963 **Characterization of 8-mil boron/aluminum material** J L Christian (General Dynamics Corp , Convair Div , San Diego, Calif) In Technology in transition, Proceedings of the Twentieth National Symposium and Exhibition, San Diego, Calif , April 29-May 1, 1975 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1975, p 129-134 Research sponsored by the General Dynamics Corp

The objective of this program was to determine the effect of boron filament diameter (8 mils versus 5 6 mils) on the mechanical

properties of boron/aluminum composite material Longitudinal and transverse tensile, shear, and longitudinal and transverse fatigue properties were evaluated on three sheets of 8-mil diameter boron/aluminum material Test results were compared with average properties of 5 6-mil boron/aluminum Because of the attractive properties and potential cost reduction associated with 8-mil boron/aluminum, it is recommended that further evaluations be pursued to qualify this material for production use (Author)

A75-40967 **Static fatigue behavior of cellulose and polyamide materials** J D Boone (U S Navy, Naval Aerospace Recovery Facility, El Centro, Calif) In Technology in transition, Proceedings of the Twentieth National Symposium and Exhibition, San Diego, Calif , April 29-May 1, 1975 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1975, p 193-202

About twenty different Federal or Military Specification materials of nylon (aliphatic polyamide), Kevlar (aromatic polyamide), linen, rayon, and cotton were tested In the tests constant loads were applied and time to failure and elongation were measured The results obtained in the tests are discussed, taking into account single constant loading, static loading at multiple levels of loading, and elongation under constant load G R

A75-40972 **Kerimid 353 bis-maleimide laminating resin** R T Alvarez and F P Darmory (Rhodia, Inc , New York, N Y) In Technology in transition, Proceedings of the Twentieth National Symposium and Exhibition, San Diego, Calif , April 29 May 1, 1975 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1975, p 253-269

Kerimid 353 is a three-component mixture of bis-maleimides This addition polyimide can be used in a solvent-free wet-winding process at 125 C (255 F) to fabricate filament wound structures, laminates, and pultruded shapes Graphite, glass, and Kevlar fibers have successfully been fabricated into laminates with Kerimid 353 Filament wound composites do not suffer from a wall thickness limitation (Author)

A75-40973 **Low-flow, low pressure curing resins** R W Vaughan, R J Jones, C H Sheppard, and G A Zakrzewski (TRW Systems Group, Redondo Beach, Calif) In Technology in transition, Proceedings of the Twentieth National Symposium and Exhibition, San Diego, Calif , April 29-May 1, 1975 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1975, p 287-295 Contract No F33615-73-C-5094

HYSTL modified epoxy (HME) resins were developed which provided Hercules A-S graphite fiber reinforced composites that were vacuum bag molded, had low resin flow during molding, possessed good fiber orientation and provided mechanical properties equivalent to those obtained with state-of-the-art epoxy resins The composite panels vacuum bag molded during this program were equivalent to autoclave molded composites using state-of-the-art epoxy resins Results from hydrolytic degradation studies demonstrated significant improvements with the HME resin over the commercially available systems Application of the HME resin for use in graphite fiber reinforced composite skins on cocured honeycomb sandwich panels is being demonstrated (Author)

A75-40985 **Weldbonding of aluminum aircraft structures** E B Mikus and A H Freedman (Northrop Corp., Hawthorne, Calif) In Technology in transition, Proceedings of the Twentieth National Symposium and Exhibition, San Diego, Calif , April 29-May 1, 1975 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1975, p 424-438 Contract No F33615-74-C-5027

Weldbonding offers excellent potential for economical and efficient joining of aluminum structures However, there are a number of problems which have prevented the production application of this process In this paper, solutions to these problems are discussed, areas where weldbonding may be applied to fighter-type aircraft are presented, and advantages of weldbonded structure over other metallic and advanced-composite structure are assessed for specific applications (Author)

A75-40992 **Preproduction evaluation of an improved titanium surface prebonding process.** R F Wegman and M J Bodnar (U S Army, Materials Engineering Div , Picatinny Arsenal, Dover, N J) In Technology in transition, Proceedings of the Twentieth National Symposium and Exhibition, San Diego, Calif , April 29-May 1, 1975 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1975, p 533-545 6 refs

A new titanium process developed to improve the durability of adhesive bonds to titanium has been evaluated for acceptability as a production process Details are discussed as to the effects of sealing-up of the solutions from laboratory to production on bond durability, metal removal and quality control The results given have been received from potential commercial users of the process (Author)

A75-40999 * **PMR polyimides - Processable high temperature composite matrix resins.** W E Winters (TRW Equipment Group, Cleveland, Ohio) and T T Serafini (NASA, Lewis Research Center, Cleveland, Ohio) In Technology in transition, Proceedings of the Twentieth National Symposium and Exhibition, San Diego, Calif , April 29-May 1, 1975 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1975, p 629-643 6 refs

Processing reproducibility and versatility were demonstrated for producing addition-cured polyimide/graphite fiber composites using a unique in situ polymerization of monomeric reactants directly on the fiber surface The polymers so derived, designated PMR polyimides, can be fabricated into composite structures by laminating, random fiber molding or autoclave curing Composites were determined to be thermally stable and retain useful properties after extended exposures at 550 to 650 F The material and fabrication capability were demonstrated by the fabrication and evaluation of prototype complex fan blades (Author)

A75-41000 **Some production experiences with composite structures** J D Forest (General Dynamics Corp , Convair Div , San Diego, Calif) In Technology in transition, Proceedings of the Twentieth National Symposium and Exhibition, San Diego, Calif , April 29-May 1, 1975 Azusa, Calif , Society for the Advancement of Material and Process Engineering, 1975, p 644-648

Two of the composite structures considered are graphite/epoxy articles for Atlas missile service One article, the Atlas bulkhead, is a flat pressure diaphragm The other is a conical interstage adapter A third application discussed involves boron/aluminum tubes which are used on the Orbiter midfuselage The performance of the composite structures is evaluated It is found that the articles show measurable performance improvements over their metal counterparts G R

A75-41100 # **Device for determining the location of the maximum climb rate of an ascending air current (Ustroistvo dlia opredeleniia mestoraspolozheniia maksimuma skoropod'emnosti voskhodiashchego potoka vozdukha)** A T Lavrova and V N Chubikov (Moskovskii Aviatsionnyi Institut, Moscow, USSR) *Pribo-rostroenie*, vol 18, no 5, 1975, p 92-96 In Russian

The problem of finding the location of the maximum climb rate of an ascending air current for glider flight applications is posed, and an approach to its solution is set which is based on comparison of the angles of attack of the two half-wings relative to each other Measuring the difference between the two angles of attack yields information on the location of the center of the upward current relative to the longitudinal axis of the glider This measurement would be accomplished by two vent openings placed on the upper and lower surfaces of each airfoil and in communication with each other via a chamber with manometric equipment P T H

A75-41179 # **Overview - Turbofan STOL transport aircraft technology** Edited by T D Pilsch (U S Air Force Academy, Colorado Springs, Colo) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 11th, Washington, D C , Feb 24-26, 1975, Paper 75-300* 13 p 31 refs

The V/STOL Aircraft Systems Technical Committee of the AIAA has prepared a survey report on the present state of technology in the development of turbofan STOL transport aircraft The survey begins with a discussion of how the unique requirements for such an aircraft influence the choice of technology to be employed The leading unpowered and powered high lift concepts are identified and compared as to performance, operational suitability, and environmental impact The development of associated technology required to support a STOL transport system is also covered (Author)

A75-41233 # **The jet flap wing in proximity to the ground, giving particular attention to large angles of attack and large jet-flap angles (Der Strahlklappenflugel in Bodennahe unter besonderer Berucksichtigung grosser Anstell- und Strahlklappenwinkel)** R Lohr Bochum, Ruhr-Universitat, Dr -Ing Dissertation, 1973 183 p 74 refs In German

A procedure is developed for the calculation of the effect of ground proximity on the aerodynamic coefficients of a jet flap wing of infinite span A computational method for a slender wing profile with a weak camber for small angles of attack is considered The method is based on the two-dimensional theory presented by Spence (1961) The method is subsequently extended to wings with large angles of attack The relationship between the aerodynamic coefficients and the angle of attack is found to be nonlinear The computed values show satisfactory agreement with experimental data G R

A75-41404 # **COMED - A combined display including a full electronic facility and a topographical moving map display** W M Aspin (Ferranti, Ltd , Edinburgh, Scotland) In Advanced Aircrew Display Symposium, 2nd, Patuxent River, Md , April 23, 24, 1975, Proceedings Patuxent River, Md , U S Naval Air Systems Command, Naval Air Test Center, 1975, p 160-171

The COMED display provides color topographical map display annotated with suitable navigation parameters, a high resolution radar display with or without radar/map matching, a high definition TV picture, tabular displays of weapon status, backup engine instrumentation, and backup primary flight instrumentation Aspects of optical design are discussed along with questions of system construction G R

A75-41405 # **Holographic horizontal display system** G T Burton (RCA, Government Communications and Automated Systems Div , Burlington, Mass) In Advanced Aircrew Display Symposium, 2nd, Patuxent River, Md , April 23, 24, 1975, Proceedings Patuxent River, Md , U S Naval Air Systems Command, Naval Air Test Center, 1975, p 172-191 Navy-sponsored research

The display system considered employs a holographic subsystem for the storage and display of multicolor aerial chart information and a rear projected CRT subsystem for the presentation of dynamic annotation and sensor information A description of the holographic concept is given The multicolor recording system is considered along with aspects of registration and address data recording, the cockpit display system, the transport interface, demonstration hardware, annotation data display, and questions of packaging G R

A75-41408 # **Vertical Display/Master Monitor Display** W C Hoffman and J L Heard (Hughes Aircraft Co , Culver City, Calif) In Advanced Aircrew Display Symposium, 2nd, Patuxent River, Md , April 23, 24, 1975, Proceedings Patuxent River, Md , U S Naval Air Systems Command, Naval Air Test Center, 1975, p 250-269

The development of two display systems intended for use in the advanced Navy all weather attack aircraft of the 1980s is discussed The Vertical Display System is one of the primary flight and sensor data display systems and presents both flight control data and sensor data for navigation and weapon delivery The Master Monitor Display is a data processing and display system conceived to provide an aircrew with an integrated presentation of information of various types G R

A75-41410 # **Pilot information requirements for air combat maneuvering** G W Hoover and J F Watler, Jr (Northrop Corp , Aircraft Div , Hawthorne, Calif) In Advanced Aircrew Display Symposium, 2nd, Patuxent River, Md , April 23, 24, 1975, Proceedings Patuxent River, Md , U S Naval Air Systems Command, Naval Air Test Center, 1975, p 295-313

The definition of the air combat maneuvering operational environment in phases is considered along with the establishment of the operational objectives of each phase Information requirements for the pilot are in part related to the establishment of the presence of other aircraft, the location of the other aircraft, the determination of the other aircraft's direction and velocity, and an evaluation of this information, taking into account factors related to the condition of the pilot himself and his aircraft Approaches to assist the pilot in his problem to make the right decision for the given conditions are briefly examined G R

A75-41411 # **Combat Energy Maneuverability Display - CEMD /Flight dynamic and fire control information integration/** E L Cloud, J N Fendley, and T A Stinnett (Westinghouse Defense and Electronic Systems Center, Baltimore, Md) In Advanced Aircrew Display Symposium, 2nd, Patuxent River, Md , April 23, 24, 1975, Proceedings Patuxent River, Md , U S Naval Air Systems Command, Naval Air Test Center, 1975, p 314-332 Research supported by the Westinghouse Independent Research and Development Program

Air combat tactical requirements are examined and combat energy management display requirements are investigated, taking into account the comparative specific energy curves for two aircraft as a function of altitude vs airspeed Display requirements include the presentation of projected time in relation to a maximum maneuver envelope, an instantaneous velocity vector, and a projected velocity vector A suitable approach for providing the needed information is discussed, giving attention to the CEMD G R

A75-41415 # **The use of in-flight simulation to develop control system and display requirements for conventional and V/STOL airplanes** E W Aiken, G W Hall, and J V Levacqz (Calspan Corp , Buffalo, N Y) In Advanced Aircrew Display Symposium, 2nd, Patuxent River, Md , April 23, 24, 1975, Proceedings Patuxent River, Md , U S Naval Air Systems Command, Naval Air Test Center, 1975, p 377-392 5 refs

The present work discusses recent research programs that clearly demonstrate the utility of in-flight simulation or variable stability airplanes in the development of flight control system and display requirements for conventional and V/STOL aircraft Interactive dynamic coupling among the elements of the pilot-airplane flight control-display system is specifically treated A research approach should include the following steps in order to establish useful system design criteria theoretical analyses using mathematical models of the human pilot in conjunction with generic aircraft/control system combinations to develop appropriate display design philosophies, a research vehicle that provides wide variations in both control characteristics and display presentations for the implementation of the hypothesized designs, and flight experiments using realistic tasks in realistic environments to test the validity of the designs S J M

A75-41474 # ***On the response of an airplane to sinusoidal gust*** M Kobayakawa, Y Takashi, and H Maeda (Kyoto University, Kyoto, Japan) *Japan Society for Aeronautical and Space Sciences, Transactions,* vol 18, June 1975, p 64-75 8 refs

The effects of aerodynamic interference between wing and tail panels on the longitudinal response of an airplane to a sinusoidally varying wind gust are investigated The response functions of an airplane to a sinusoidal gust are calculated theoretically on the basis of Reissner's method, while the response functions and phase differences between the gust and the lift force are determined experimentally using an airplane model in a low-speed wind tunnel The results show that the response functions increase with increasing tail height and decrease with increasing distance between wing and tail F G M

A75-41598 # **A contribution to the design of digital self-adaptive flight control systems (Ein Beitrag zum Entwurf digitaler, selbstadaptiver Flugregelsysteme)** U Hartmann Hannover, Technische Universitat, Fakultat fur Maschinenwesen, Dr -Ing Dissertation, 1974 158 p 50 refs In German Research supported by the Bundesministerium der Verteidigung

An approach for the design of a digital adaptive flight controller is discussed, giving particular attention to questions of implementation A description of the controlled parameters is given, a design procedure for the completely measurable state vector is derived, and two design examples are presented Processes for the case in which the state parameters are not measurable are also considered Methods for the identification of state models on the basis of input and output measurements are considered along with the function of the self-adaptive flight control system G R

A75-41630 * # **FCAP - A new tool for the evaluation of active control technology** R B Noll (Aerospace Systems, Inc , Burlington, Mass) and L Morino (Boston University, Boston, Mass) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1059* 10 p 15 refs Contract No NAS1-13371

A computer program has been developed for the evaluation of flight control systems designed for flexible aircraft This Flight Control Analysis Program (FCAP) is designed in a modular fashion to incorporate sensor, actuator, and control logic element dynamics as well as aircraft dynamics and aerodynamics for complex configurations Formulation of the total aircraft dynamic system is accomplished in matrix form by casting the equations in state vector format The system stability and performance are determined in either the frequency or time domain using classical analysis techniques The aerodynamic method used also permits evaluation of the flutter characteristics of the aircraft (Author)

A75-41631 # **Use of fly-by-wire to obtain performance improvements in a delta-canard design** B J Kuchta (General Dynamics Corp , Convair Aerospace Div , San Diego, Calif) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1061* 11 p

This paper describes the performance benefits that can be gained through application of fly-by-wire (FBW) and relaxed static longitudinal stability to a high-performance, delta-wing fighter aircraft Relaxed static stability (RSS) is obtained by incorporating a controllable, close-coupled canard that is positioned to generate favorable aerodynamic interference with the wing The RSS concept, combined with FBW, provides increased maneuverability, reduced trim drag, lower wing load, well-distributed fuselage loads The net result is a weight reduction of about one thousand pounds when the RSS/FBW delta-canard configuration is compared to a conventional wing-tail configuration designed for the same mission Control laws for optimum canard-elevon gearing are discussed, as are techniques for determining control power requirements (Author)

A75-41640 # **Development of automatic terrain-following/automatic terrain-avoidance decoupling techniques.** L U Nardi and H Y Kawana (Rockwell International Corp , Los Angeles, Calif) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1074* 11 p Contract No F33615-73-C-3062

This paper describes the synthesis and evaluation of several control laws for independent decoupled control of the horizontal and vertical flight path vectors during automatic terrain-following/automatic terrain-avoidance (ATF/ATA) operations Simultaneous control of both vertical (ATF) and lateral (ATA) maneuvers induces an undesired coupling between axes and greatly reduces low-altitude penetration performance The nature of the coupling problems and the control system design techniques utilized in the ATF/ATA coupler control law development are presented in detail The coupling performance is demonstrated in a simulation study to show the benefits achievable when applied to a high-performance strategic bomber (Author)

A75-41641 # **Integrated flight/propulsion control by state regulation** W R Seitz (Bendix Research Laboratories, Southfield, Mich) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75 1075* 8 p 8 refs

The application of modern control theory to integrated flight/propulsion control system design is receiving increased attention Future control configured aircraft with variable geometry engines will have operating modes that involve radically interacting airframe and thrust effects Linear state regulator theory, with its ability to accommodate large order, multivariable systems, appears to be well suited to the control synthesis task Automated design procedures allow the control designer great flexibility and facilitate the investigation of more alternatives in the evolution of a design Results from an exercise with conventional airframe and engine models illustrate the design procedure (Author)

A75-41642 # **Aircraft optimal weapon delivery maneuvers based on extended energy management** A J Calise, R Aggarwal (Dynamics Research Corp , Systems Div , Wilmington, Mass), and G M Anderson (USAF, Institute of Technology, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1076* 11 p 10 refs Contract No F08635-73-C 0076

Optimal, three-dimensional weapon delivery maneuvers for launching an air-to-air missile are derived using an Extended Energy Management approach The attacking aircraft is controlled to achieve an optimal relative position to the target prior to missile launch for the stated initial conditions and terminal constraints at launch An algorithm for defining the attacker's optimal control as a function of current target state and turn rate was developed and used in a point mass 3DOF simulation Attacker trajectories are shown for varying launch conditions Each trajectory results from a single integration of the equations of motion forward in time Numerical comparisons are made to optimal solutions computed using an iterative gradient algorithm Both high speed and low speed yo-yo type maneuvers are exhibited (Author)

A75-41643 * # **Wind modeling and lateral control for automatic landing** W E Holley (Oregon State University, Corvallis, Ore) and A E Bryson, Jr (Stanford University, Stanford, Calif) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1077* 11 p 27 refs Grant No NGL-05-020-007

For the purposes of aircraft control system design and analysis, the wind can be characterized by a mean component which varies with height and by turbulent components which are described by the von Karman correlation model The aircraft aero-dynamic forces and moments depend linearly on uniform and gradient gust components obtained by averaging over the aircraft's length and span The correlations of the averaged components are then approximated by the outputs of linear shaping filters forced by white noise The resulting model of the crosswind shear and turbulence effects is used in the design of a lateral control system for the automatic landing of a DC-8 aircraft (Author)

A75-41644 * # **Time-controlled descent guidance in uncertain winds** G Menga and H Erzberger (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1078* 10 p 13 refs

A procedure has been developed for constructing a statistical model of the altitude-dependent mean wind profile from the historical record of wind measurements at particular locations The model is constructed by fitting a Markov process, with altitude as the stage variable, to the historical wind data The wind model, together with the aircraft dynamics and the error characteristics of the navigation system, are incorporated in the design of a state estimator, which gives the minimum variance estimate of the aircraft state and the wind vector The state and wind estimates are used as inputs to a linear feedback law for guiding the aircraft along the nominal trajectory An example design of a time constrained (4D RNAV) descent guidance system is presented, showing tracking accuracy, control activity, and probability of arrival time with and without the wind estimator (Author)

A75-41648 # **Design of an improved azimuth reference system** B M Mertz (USAF, Test Group, Holloman AFB, N Mex) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1083* 5 p

An improved azimuth reference facility has been developed to provide increased accuracy required for the alignment and testing of 'state-of-the-art gyrocompassing devices The facility permits evaluation of the various error sources involved with the determination of azimuth by astronomical, geodetic and inertial means The system incorporates current techniques for measuring, transferring and storing azimuth in an attempt to determine optimum procedures The system also includes a highly instrumented, automated azimuth reference monument containing optical and inertial azimuth storage devices, seismometers, tiltmeters and additional environmental sensors An exterior weather station is also included in that system The continuous and systematic evaluation of the outputs of those instruments results in an improved azimuth reference capability (Author)

A75-41649 # **Effects of sampling rate and transformation techniques on the design of digital notch filters** G E Lang and J G McGough (Bendix Corp , Teterboro, N J) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1084* 10 p

Automatic flight control system design for high performance aircraft requires high bandwidth and, therefore, effective means of attenuating or controlling the structural bending modes This, in turn, involves the use of rather complex notch filters When utilizing digital computers, these compensators may require high sampling rates and considerable memory, thus constraining the digital computer cost, reliability and availability The paper discusses several techniques for transforming continuous functions to discrete functions for the purpose of designing better digital filters (Author)

A75-41650 # **Digital multimode flight control system** T R Yechout (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and D R Oelschlaeger (Honeywell, Inc , Minneapolis, Minn) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1085* 9 p

A digital multimode flight control system has been developed and flight tested on an A-7D tactical aircraft by the Air Force Flight Dynamics Laboratory and Honeywell Inc Dual-redundant, whole-word digital processors are used to compute the inner-loop stability and control augmentation functions and outer-loop pilot relief functions for the A-7D The system features pilot selectable control modes (multimodes) designed to enhance tracking performance by tailoring aircraft handling qualities to specific weapon delivery tasks This program is the first Air Force digital flight control flight test effort and, as such, is intended to provide a baseline for future digital and multimode flight control applications including fly-by-wire (Author)

A75-41651 # **Digital flight control for advanced fighter aircraft** R Gran, H Berman, M Rossi, and D Rothschild (Grumman Aerospace Corp , Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass., Aug 20-22, 1975, Paper 75-1086* 10 p 9 refs

The operating characteristics of the next generation of fighter aircraft impose severe constraints which the control systems of these aircraft must overcome The use of linear optimal digital control techniques allows one to answer some of the outstanding questions concerning how to design digital fly-by-wire control systems By using an 'implicit model following' technique we have found that design specifications may be easily incorporated into the controller By concentrating on noise and uncertainty we have found how to maximize the computer sample time, thereby reducing computer utilization By appropriately incorporating all control surfaces we have found how to use these controls harmoniously to achieve the desired performance Finally, all of these have been accomplished with a set of computer-aided design programs that are easily used and give rapid results This paper describes the theoretical basis of our techniques and its application to a typical 1980's advanced fighter aircraft (Author)

A75-41652 # **YC 14 digital flight control data management** R E Kestek (Boeing Aerospace Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1087* 6 p

The YC-14 Electrical Flight Control System digital computers are required to process analog, discrete and serial digital input data in performing the flight control tasks The three channel system must process data so that identical data are available to each computer A second requirement is to minimize the time delay between the input of data and the output of results computed from the data (Author)

A75-41653 # **Balanced functional design of automatic digital flight control systems** D B Mulcare and J W Benson (Lockheed-Georgia Co , Marietta, Ga) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1088* 10 p 5 refs

Emphasis is placed upon the practical consideration of the total loop with all its functional effects and characteristics in achieving a comprehensive and balanced control-system design The analytical development phase, which is crucial to the design process, receives particular attention in the form of a recommended methodology This includes extensive use of hybrid simulation and concurrent analog and digital mechanization development to reduce risk and schedule span As an example, the digital implementation of a priori inner-and outer-loop control laws is undertaken, and the resultant configuration is analyzed and refined Stability margins are the limiting factors in minimizing sampling rates, but the granularity of the control column and surface motions of the outer-loop mode place corresponding restrictions (Author)

A75-41654 # **Propagation of gravity gradiometer errors in an airborne inertial navigation system** M A Gerber (TRW Systems Group, Redondo Beach, Calif) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1089* 9 p 12 refs Contract No F04701-74-C-0327

The characteristics of gravity gradiometer error propagation in a horizontal channel of an inertial navigation system moving at aircraft speed near the earth are studied The analysis considers white noise, time-correlated noise, random constant bias, and random constant drift gradiometer errors A Kalman filter is used to process the gradiometer measurements and provide corrections to the inertial system for gravity-induced errors The filter is formulated to estimate

the errors in gravity, the gradiometers, and the inertial navigation system The error behavior is then determined by numerical propagation of the filter's covariance equation Transient errors produced by bias and bias drift are found to be dominant for the first Schuler cycle while long-term performance is primarily governed by random noise in that part of the spectrum near the Schuler frequency (Author)

A75-41655 # **Accuracy improvement in a gravity gradiometer-aided cruise inertial navigator subjected to deflections of the vertical** C Grubin (Hughes Aircraft Co , El Segundo, Calif) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1090* 11 p 7 refs

This paper develops navigation error equations for a gravity gradiometer-aided single-axis Schuler cruise navigator and compares the errors numerically with those for an unaided navigator when both are driven by the same anomalous gravity The model for anomalous gravity is a distribution of point masses whose strengths and locations are randomly chosen so that the statistics on the vertical deflection agree with measured data Since the gradiometer has a bias error, its output is only imperfectly integrated, typically, the integration time constant is 1-5 hours The paper examines the effect of instrument biases, scale factor and misalignment errors, gravity anomaly initialization errors, and Schuler resonance on navigation accuracy Of these, the most important error is a bias since it can produce large position errors Simple formulas for predicting peak velocity error and steady state position error due to a bias are given (Author)

A75-41663 # **The use of autocorrelation functions to predict the effects of vertical deflections on aircraft navigation** U Bernstein and R I Hess (Logicon, Inc , San Pedro, Calif) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1101* 6 p 8 refs

Autocorrelation functions (ACFs) of surface gravity anomalies are used as a method of predicting expected aircraft navigation errors induced by deflection model uncertainties Theoretical methods are developed to propagate ACFs from the surface to aircraft altitudes, to determine ACFs of vertical deflection components from ACFs for gravity anomalies, and to predict average position and velocity uncertainties in the aircraft navigation system which arise from uncertainties in modeling vertical deflections Numerical results include a study of navigation error sensitivities to system parameters and estimates of representative navigation errors implied by using several specific deflection models in the U S (Author)

A75-41671 # **Inertially aided ranging for guidance systems** C M Brown, Jr , C F Price (Analytic Sciences Corp , Reading, Mass), and W H Licata (U S Navy, Naval Surface Weapons Center, Silver Spring, Md) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75 1109* 8 p Contract No N60921-74-C-0235

This paper demonstrates the feasibility of an inertially aided ranging technique for use in an airborne guidance system The technique employs a data processing algorithm, based upon optimal estimation theory, which estimates range and range rate to a surface target in cases where these quantities cannot be measured directly The algorithm design is evaluated by calculating its associated root-mean-square range and range-rate estimation errors, making use of a realistic analytical model of the system dynamics and sensor error sources Sensitivity results are included to demonstrate the effects of target maneuver characteristics, measurement noise level, and trajectory peak altitude (Author)

A75-41673 # **On the design of a model reference adaptive flight control system** P N Nikiforuk, M M Gupta (Saskatchewan, University, Saskatoon, Canada), K Kanai, and H Adachi (National Defense Academy, Yokosuka, Japan) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1111* 9 p 11 refs National Research Council of Canada Grants No A-5625, No A-1080, Defence Research Board of Canada Grants No 4003-02, No 9781-06

Three different approaches for the design of a model reference adaptive controller for an aircraft flight control system are developed The aircraft is assumed to be operating over a wide range of parameters in an uncertain environment In these approaches the desired handling qualities of the aircraft system are represented in terms of a model, and the adaptive controller forces the aircraft system to track the model as closely as desired The designs are based upon Liapunov stability methods The first approach uses the parameter adaptation of the feedback and feedforward paths of the aircraft system The second and third approaches use the signal synthesis adaptive method The feasibility of these approaches was investigated by simulating a typical aircraft system (Author)

A75-41680 # **Determination of aerodynamic coupling derivatives through flight test** T R Driscoll, R C Stockdale, and F J Schelke (Martin Marietta Aerospace, Orlando, Fla) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1119* 7 p

The control of a highly responsive surface-to air missile is dependent upon the aerodynamic characteristics of the selected airframe Although the aerodynamic forces and moments are obviously important, the partial derivatives of these variables are the primary characteristics that determine the stability of the control system Of particular interest are the aerodynamic coupling derivatives (those forces and moments induced in one autopilot channel by changes in another channel) These coupling characteristics can be accurately determined during the flight test program by (1) including test sequences that excite these coupling forces and produce a measurable response, and (2) developing a technique to equate these flight test responses to numerical values of the aerodynamic derivatives This paper describes such a technique developed for a typical surface-to air missile and presents results based on actual flight test sequences (Author)

A75-41682 # **Optimal design of a Mini-RPV lateral autopilot** I Y Bar-Itzhack (Technion - Israel Institute of Technology, Haifa, Israel) and E Ferdman *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1121* 10 p 10 refs

In this paper the design of a lateral autopilot for a miniature remotely piloted vehicle (RPV) is described The structure of the autopilot is predetermined, as well as the measured variables Even though aileron alone is used to control the RPV, the system is completely controllable Using several indices of performance the best autopilot gains are determined by minimizing these indices The minimization is carried out in the complex plane and comparison is made with state space methods When a single error, such as heading error, is considered, the complex plane minimization procedure is superior The RPV poles due to the Dutch roll mode stay close to the imaginary axis, although heavy penalty is imposed by the performance index on a persisting error The pole placement is restricted by the fact that the trace of the system matrix is constant Although no rudder is used, the vehicle executes coordinated turns due to its natural coordination quality (Author)

A75-41683 # **Automatic control of drones and RPV's in formation** W H Lee, Jr and L T Richardson (IBM Corp , Federal Systems Div , Huntsville, Ala) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1122* 8 p Grant No DAAH01-74-C-0523, Contract No F30602-74 C-0097

A system for automatic formation control of target vehicles has been developed and successfully demonstrated by flight testing The system, which was designed for navigation, guidance, and control of up to six vehicles simultaneously, employs distance measuring

equipment (DME) for tracking/navigation Simulation was employed extensively to minimize risks and reduce flight testing time The system and the tools used in its development and evaluation are described Also presented are results of flight tests of two MQM-34D target vehicles guided along precise flight paths in closely spaced formation (Author)

A75-41684 * # **Optimum flight profiles for short haul missions** H Erzberger, J F Barman, and J D McLean (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass., Aug 20-22, 1975, Paper 75-1124* 12 p 8 refs

An algorithm, based on the energy-state method, is derived for calculating optimum trajectories with a range constraint The basis of the algorithm is the assumption that optimum trajectories consist of, at most, three segments an increasing energy segment (climb), a constant energy segment (cruise), and a decreasing energy segment (descent) The algorithm is used to compute minimum fuel, minimum time, and minimum direct-operating-cost trajectories, with range as a parameter, for an in-service CTOL aircraft and for an advanced STOL aircraft Use of a simplified trajectory increases the fuel consumption of the total descent trajectory by about 10 percent and the time to fly the descent by about 19 percent compared to the optimum (Author)

A75-41685 # **Conflict resolution maneuvers in an Intermittent Positive Control system** P A Palicio and J F Golden (Mitre Corp , McLean, Va) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1125* 10 p U S Department of Transportation Contract No FA70WA-2448

This paper compares the effectiveness of horizontal and vertical collision avoidance maneuvers in an Intermittent Positive Control (IPC) system by studying the results of a Monte Carlo simulation of encounters between two aircraft Several combinations of low performance and high performance aircraft, with both in straight flight or with one turning into the other, are simulated and the results are analyzed The analysis has been used to improve IPC design by providing for both the selection of a more effective detection algorithm and the refinement of the resolution rules to include a decision on the more appropriate type of primary maneuver (horizontal or vertical) to solve different kinds of encounters It is recommended that horizontal maneuvers be used for solving encounters between low performance aircraft For solving encounters between high performance aircraft, and between a high performance and a low performance aircraft, vertical maneuvers are the best choice (Author)

A75-41686 * # **Flight experience with time-of-arrival control for STOL aircraft in the terminal area** F Neuman and H Q Lee (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Guidance and Control Conference, Boston, Mass , Aug 20-22, 1975, Paper 75-1126* 9 p 6 refs

A research program on STOL operating systems is underway at the Ames Research Center One investigation is concerned with design, analysis, and flight test of promising four-dimensional RNAV systems One promising system generates a capture flight path from the present aircraft position to a waypoint on a selected fixed STOL approach route It predicts arrival time at the runway and controls time and position along the path The system was flight tested using a digital avionics system on a Convair 340 and on an experimental powered-lift STOL airplane Flight tests in the flight director mode show that the pilot can choose and change the desired time of arrival, and meet this time within a few seconds, in spite of navigation errors and varying winds Initial tests of the automatic mode using a flight simulator and the NASA Augmentor Wing Jet STOL Research Aircraft (AWJSRA) show that good time control was achieved at the cost of excess throttle activity This fault was later corrected (Author)

A75-41689 * # **Techniques for determining propulsion system forces for accurate high speed vehicle drag measurements in flight** H H Arnaiz (NASA, Flight Research Center, Edwards, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-964* 14 p 6 refs

As part of a NASA program to evaluate current methods of predicting the performance of large, supersonic airplanes, the drag of the XB-70 airplane was measured accurately in flight at Mach numbers from 0 75 to 2 5 This paper describes the techniques used to determine engine net thrust and the drag forces charged to the propulsion system that were required for the in-flight drag measurements The accuracy of the measurements and the application of the measurement techniques to aircraft with different propulsion systems are discussed Examples of results obtained for the XB-70 airplane are presented (Author)

A75-41690 # **PABST - A technology demonstrator** E W Thrall, Jr (Douglas Aircraft Co , Long Beach, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-989* 10 p

The objective of the Primary Adhesively Bonded Structure (PABST) program is to improve the structural integrity and durability of future Air Force aircraft while providing significant cost of-ownership savings This paper presents the structural design arrangement selection process which examines static strength, fatigue, and damage tolerance criteria The surface treatment optimization program, which examines phosphoric acid and chromic acid anodize (using optimized FPL etch as a standard) is reviewed with current test results The maximized corrosion resistance afforded by these surface treatments is the key to increased durability The adhesive selection process is presented with test data The proposed structural development test plans are discussed The paper concludes with the projected design, manufacture, and test plans for the full scale advanced development program (ADP) component This 52-foot section is the entire cargo compartment of the YC-15 aircraft (Author)

A75-41691 # **Thermostructural and material considerations in the design of the F-14 aircraft transparencies** S Z Fixler (Grumman Aerospace Corp , Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif , Aug 4-7, 1975, Paper 75-990* 12 p 8 refs

Thermostructural and material aspects in the design of the F-14 aircraft transparencies are presented An attempt is made to trace the evolution of the final design configuration, and its in-service-dictated modifications, under the constraints of cost, weight and schedule without sacrificing vital performance Design requirements are given and the transparencies along with the systems that affect the load and thermal environments are fully described Results of tradeoff studies between monolithic and multilaminate configurations are shown Windshield and canopy temperature and thermal stress distributions are presented for acrylics and polycarbonates Transparency material ranking criteria are given Results of an analytical and experimental investigation on the effects of extreme thermal environments on canopy distortions are presented Predicted and in flight measured canopy temperature correlations are shown It is shown how various factors influenced the crucial decision processes that were vital in arriving at a successful design configuration (Author)

A75-41692 # **Advanced high lift design through analytical/experimental techniques** J A Braden, L Barnett, A E Holmes, and M E Carlton (Lockheed-Georgia Co , Marietta, Ga) *American Institute of Aeronautics and Astronautics, Aircraft Systems and*

Technology Meeting, Los Angeles, Calif., Aug 4-7, 1975, Paper 75-992 20 p 37 refs

Several analytical techniques are discussed which deal with two-dimensional multi-element airfoil viscous flow analysis, three-dimensional utilization of section data so derived, calculation methods for powered lift systems, and the need to recognize non-planar wake effects in three-dimensional high lift calculations when lift performance exceeds certain limits Capabilities of the methods are also illustrated This is followed by a description of a new, broad purpose, high lift technology (HLT) wind tunnel model and of the utilization of the analytical methods to design its double slotted mechanical flap system Leading edge blowing with mechanical flaps and Coanda flaps is also discussed Experimental performance of the HLT model is also shown, including comparisons with analytical estimates These comparisons include mechanical flaps with and without leading edge blowing It is especially significant that the leading edge slat gap and deflection design optimization for lift, which was conducted in the attached flow region, was experimentally shown to also be a valid optimization for maximum lift (Author)

A75-41693 # **DC-9 flight testing of the refanned JT8D engine** E M Lowder and R C Hanwell (Douglas Aircraft Co., Long Beach, Calif.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif., Aug 4-7, 1975, Paper 75-998* 9 p 7 refs

Two refanned JT8D engines, each equipped with a larger single-stage fan and an acoustically treated nacelle, were installed and tested on a DC-9 30 airplane The primary noise tests consisted of takeoff and approach-related flyover runs that were consistent with FAR test procedures Survey-type flyovers were also conducted to obtain data to complete a basic map of flyover noise as a function of engine power and airplane height Other noise measurements were obtained to evaluate the relative strengths of the various engine-noise components Considerable testing was done to assess the effect of the refanned engine and its installation on flightworthiness and basic airplane/engine performance The results indicate that significant noise reduction was achieved and that flight characteristics and structural integrity were acceptable (Author)

A75-41694 # **The results of fabrication and testing of the prototype composite rotor blades for HLH and UTTAS** T S Scarpati, R J Feenan, and W K Stratton (Boeing Vertol Co., Philadelphia, Pa.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif., Aug 4-7, 1975, Paper 75-1010* 16 p

This paper tells how the detailed configurations of the composite rotor blades for Boeing Vertol's HLH and UTTAS helicopters were developed It presents the major reasons and design considerations for each material selection Results of fabrication and testing of the initial prototype blades are also presented and compared to initial predictions for strength and fabrication manhours The design and fabrication problems are highlighted, along with their solutions A production, design-to-cost configuration, developed from integration of the results of the three-year development program, is presented (Author)

A75-41695 * # **Design of a V/STOL technology airplane** J M Zabinsky (Boeing Commercial Airplane Co., Seattle, Wash.) and R W Burnham (Boeing Aerospace Co., Seattle, Wash.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif., Aug 4-7, 1975, Paper 75-1012* 7 p 11 refs Contract No NAS2-6563

A two-engine three-fan V/STOL airplane was designed to demonstrate and develop the technology for operational V/STOL and STO-VL aircraft having safe engine-out characteristics Engine-out requirements, integration of propulsion and aerodynamic controls, and propulsion installation are the major factors affecting the configuration Use of variable pitch fans enhances the control system providing a responsive and versatile airplane The ability to operate over the entire flight spectrum from zero speed to M = 0 8 is required to demonstrate operational capability with a V/STOL system (Author)

A75-41696 # **Aerodynamic design of the Boeing YC-14 advanced medium STOL transport /AMST/** F W May and G E Bean (Boeing Commercial Airplane Co., Seattle, Wash.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif., Aug 4-7, 1975, Paper 75-1015* 11 p 6 refs

Development of the USAF/Boeing YC-14 prototype configuration has challenged the designer to couple the latest in aerodynamic technology with a unique configuration concept which provides remarkable STOL performance while maintaining efficient cruise capability and safe handling characteristics STOL performance is achieved through the application of a new powered lift technique known as Upper Surface Blowing, in which the exhaust of the twin high bypass ratio turbofan engines is directed over the upper surface of the wing and flap and deflected by the Coanda effect Successful integration of the propulsion/powered lift system into a cruise configuration using advanced technology airfoils and extensive tailoring of the wing, nacelle and large cross-section fuselage has produced an airplane capable of safe and efficient operation over a wide spectrum of airlift missions (Author)

A75-41698 * # **Fuel conservation possibilities for terminal area compatible transport aircraft** G W Hanks (Boeing Commercial Airplane Co., Seattle, Wash.) and A R Heath, Jr (NASA, Langley Research Center, Hampton, Va.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif., Aug 4-7, 1975, Paper 75-1036* 14 p 7 refs Contract No NAS1-12018

Design characteristics that would reduce mission fuel consumption and improve terminal area operations for advanced transports are discussed Sensitivity studies of the effects of cruise speed, wing geometry, propulsion cycle, operational procedures, and payload on fuel usage are presented and utilized to arrive at a conceptual configuration which offers mission fuel savings as well as desirable operational characteristics in the terminal area Technical and economic evaluation is provided in the form of a comparison of the resulting configuration with transports reflecting the current level of technology The research and technology programs required to realize potential benefits are described (Author)

A75-41699 # **Automatic all-weather landing control** R R Wilz (U S Navy, Naval Electronic Systems Command, Washington, D C.) and R L Johnson (ITT Gilfillan, Van Nuys, Calif.) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Meeting, Los Angeles, Calif., Aug 4-7, 1975, Paper 75-1021* 11 p

The Marine Air Traffic Control and Landing System (MATCALS) is being developed by the Naval Electronic Systems Command to upgrade Air Traffic Control and All-Weather Landing Control capabilities at Marine Corps expeditionary airfields This paper addresses the All-Weather Landing Segment (ALS) of MATCALS, particularly the automatic landing capability The AN/TPN-22 Precision Approach and Landing Radar and those major landing control features that provide interoperability with other landing systems are emphasized A discussion is presented of the semiautomatic landing service that is available to all aircraft from ALS without the need for additional aircraft avionics (Author)

A75-41702 **Air safety as seen from the tower** J K King *IEEE Spectrum*, vol 12, Aug 1975, p 67-71

The proposal is made to implement a computerized airborne collision avoidance system which is pilot-monitored, aircraft contained, and independent of ground control It is pointed out that the continued reliance upon a ground based controller-monitored

system is leading inevitably to reduced safety and efficiency, and less orderly regulation in the movement of air traffic in the U S The factors against ground-controlled ATC are examined and a detailed analysis of the adverse elements is conducted G R

A75-41703 Air safety - The view from the cockpit. W B Cotton (International Federation of Air Line Pilots Association, Washington, D C) *IEEE Spectrum*, vol 12, Aug 1975, p 71-74

The review of air safety control trends is centered on the effects of an automation program, known as the Upgraded Third Generation Air Traffic Control System (UG3RD), should it be implemented, on current air-to-air separation standards, and on navigation, surveillance, and communications A critical discussion of the UG3RD shows that the system not only will do nothing to improve a pilot's capability to plan or execute more economical flight paths, but it will erode the pilot's ability to direct those paths Moreover, the design of flow control, metering and spacing, and ATC communications by data link decreases the pilot's awareness of the outside environment (weather phenomena, geographical position, near-term future flight path, and relationship to other aircraft in the area) The most serious criticism of the UG3RD relates to the implied philosophy of control and the location of responsibility V P

A75-41798 # Air cushion take-off and landing systems for aircraft J C Vaughan, III (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *(Canadian Aeronautics and Space Institute, Canadian Symposium on Air Cushion Technology, 8th, Toronto, Canada, Sept 11, 1974) Canadian Aeronautics and Space Journal*, vol 21, June 1975, p 205-209

Three aircraft have been equipped with an Air Cushion Landing System (ACLS) to replace their more conventional takeoff and landing gear The ACLS concept is discussed along with ACLS advantages, new ACLS technology, and launch and recovery methods for Remotely Piloted Vehicles (RPVs) Possible uses of ACLS are related to RPVs, small utility aircraft, fighters, bombers, and extremely large aircraft G R

STAR ENTRIES

N75-28003*# Lockheed-Georgia Co Marietta
THEORETICAL AND EXPERIMENTAL STUDY OF A NEW METHOD FOR PREDICTION OF PROFILE DRAG OF AIRFOIL SECTIONS
S H Goradia and D E Lilley Washington NASA Jun 1975 166 p refs
(Contract NAS1-12170)
(NASA-CR-2539) Avail NTIS HC $6 25 CSCL 01A

Theoretical and experimental studies are described which were conducted for the purpose of developing a new generalized method for the prediction of profile drag of single component airfoil sections with sharp trailing edges This method aims at solution for the flow in the wake from the airfoil trailing edge to the large distance in the downstream direction the profile drag of the given airfoil section can then easily be obtained from the momentum balance once the shape of velocity profile at a large distance from the airfoil trailing edge has been computed Computer program subroutines have been developed for the computation of the profile drag and flow in the airfoil wake on CDC6600 computer The required inputs to the computer program consist of free stream conditions and the characteristics of the boundary layers at the airfoil trailing edge or at the point of incipient separation in the neighborhood of airfoil trailing edge The method described is quite generalized and hence can be extended to the solution of the profile drag for multi-component airfoil sections Author

N75-28004*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
PROCEDURES FOR THE DESIGN OF LOW-PITCHING-MOMENT AIRFOILS
Raymond L Barger Washington Aug 1975 22 p refs
(NASA-TN-D-7982 L-10114) Avail NTIS HC $3 25 CSCL 01A

The pitching moment of a given airfoil is decreased by specifying appropriate modifications to its pressure distribution, by prescribing parameters in a special formula for the Theodorsen epsilon-function, and with superposition of a thickness distribution and subsequent tailoring Advantages and disadvantages of the three methods are discussed Author

N75-28007 Virginia Polytechnic Inst and State Univ Blacksburg
PREDICTION OF THE STEADY AERODYNAMIC LOADS OF LIFTING SURFACES HAVING SHARP-EDGE SEPARATION Ph D Thesis
Osama A Kandil 1974 165 p
Avail Univ Microfilms Order No 75-15877

A nonplanar discrete-vortex technique was developed The method is capable of obtaining the shapes of the wakes emanating from the sharp edges (e g the trailing edge wing tip and leading edge) as part of the solution The distributed and total aerodynamic loads on the lifting surfaces were predicted without restrictions on aspect ratios angles of attack (as long as vortex bursting or boundary-layer separation on the wing surface did not occur), and planforms The effect of thickness and level angle of the sharp edges was taken into account using two nonplanar vortex lattices one on each surface of the wing The technique was extended to solve the problem of interacting lifting surfaces Rectangular, swept-back and delta wings are presented as numerical examples The results show the problem of interacting lifting surfaces to be in qualitative agreement with the experimental observations Dissert Abstr

N75-28011# Advisory Group for Aerospace Research and Development Paris (France)
SPECIALISTS MEETING ON WING-WITH-STORES FLUTTER
Apr 1975 134 p refs Partly in FRENCH and partly in ENGLISH Presented at 39th Meeting of the Struct and Mater Panel Munich 6-12 Oct 1974
(AGARD-CP-162) Avail NTIS HC $5 75

This conference proceedings consists of nine papers which deal with the difficult problem of wing store flutter The latest state-of-the-art is examined improved methods for avoiding restrictive placarding and for rapidly and economically evaluating the many possible store combinations are presented and possibilities for optimizing the design procedure with regard to wing/store combinations are discussed

N75-28012 Royal Aircraft Establishment Farnborough (England) Structures Dept
CALCULATION METHODS FOR THE FLUTTER OF AIRCRAFT WINGS AND EXTERNAL STORES
T Niblett and J C A Baldock *In* AGARD Specialists Meeting on Wing-With-Stores Flutter Apr 1975 7 p refs

Theoretical work at RAE on the wing-with-stores problem is reported which was in the fields of structural representation, the solution of the flutter equations and the prediction of flutter characteristics from structural properties The subjects covered are (1) a comparison of the normal modes calculated for a wing-with-stores from some of the normal modes of the bare wing and discrete-load-modes with those calculated from the full flexibility matrix, (2) the basis of a computer program which traces the loci of constant flutter speeds when two structural parameters vary, and (3) the interpretation of the loci of constant flutter speed in terms of modal shapes and frequencies with the object of assessing the most critical store combinations Author

N75-28013 British Aircraft Corp Warton (England)
UK JAGUAR EXTERNAL STORE FLUTTER CLEARANCE
C G Lodge and M Ormerod *In* AGARD Specialists Meeting on Wing-With-Stores Flutter Apr 1975 24 p

The flutter clearance of U K Jaguar using a combination of mathematical modelling ground resonance and flight testing leading ultimately to clearance of a wide range of under wing stores Some improvements in modal modelling techniques are outlined These should enable reductions in future ground and flight testing times to be made Author

N75-28014 Office National d Etudes et de Recherches Aerospatiales Paris (France)
FLUTTER OF WINGS EQUIPPED WITH LARGE ENGINES IN POD
R Destuynder *In* AGARD Specialists Meeting on Wing-With-Stores Flutter Apr 1975 12 p refs In FRENCH ENGLISH summary

Calculations and measurements of unsteady aerodynamic forces performed in subsonic flow on a model equipped with an engine in pod showed that the interference between engine and wing remains negligible It was also shown that the aerodynamic forces induced on the engine itself by its own oscillation are important and give a significant contribution to the generalized forces Account was taken of these two remarks and the aerodynamic forces were calculated separately on the engine which was assimilated to a thin walled cylinder with internal and external flow in the axial direction An application to a flutter case shows the importance of the contribution of the forces on the engine A good agreement was obtained between theory and experiment at Mach number M - 0 80 Author

N75-28015 National Aerospace Lab , Amsterdam (Netherlands)
CALCULATION OF AERODYNAMIC LOADS ON OSCILLATING WING/STORE COMBINATIONS IN SUBSONIC FLOW
B Bennekers R Roos and R J Zwaan *In* AGARD Specialists

Meeting on Wing-With-Stores Flutter Apr 1975 13 p refs

A method for the calculation of aerodynamic loads on wing-store configurations oscillating in subsonic flow is presented In this method the linearized equation for subsonic compressible flow is transformed into two sets of integral equations for the steady and a superimposed unsteady flow field The wing loads are represented by dipole distributions (wing thickness is neglected) and the store loads by source distributuons Discretizing these distributions into lifting lines and source panels of constant strength results into a set of algebraic equations These are solved for the unknown distributions by forcing the flow to be tangential to the surfaces of the oscillating wings and bodies in a set of control points The solution enables the calculation of pressure distributions on the wings and stores and of generalized aerodynamic coefficients Calculated results are presented and compared with experiments Author

N75-28016 National Aerospace Lab Amsterdam (Netherlands)
ANALYSIS OF MEASURED AERODYNAMIC LOADS ON AN OSCILLATING WING-STORE COMBINATION IN SUBSONIC FLOW
L Renirie *In* AGARD Specialists Meeting on Wing-With-Stores Flutter Apr 1975 15 p refs

An analysis is given of aerodynamic loads measured with an oscillating wind tunnel model representing a wing with a tip tank and a removable pylon with store Attention is paid to the interference effects on the wing load and to the pylon store load in low and high subsonic flow Author

N75-28017 Messerschmitt-Boelkow G m b H , Ottobrunn (West Germany)
WING WITH STORES FLUTTER ON VARIABLE SWEEP WING AIRCRAFT
O Sensburg A Lotze and G Haidl *In* AGARD Specialists Meeting on Wing-With-Stores Flutter Jul 1945 19 p refs

Wing mounted stores with varying mass and inertia are discussed in conjunction with variable wing geometry for fighter aircraft Modified branch mode techniques were used to obtain the frequencies and modeshapes of the coupled system It is shown that only free dynamically scaled total aircraft models give good correlation when turning effects occur F O S

N75-28018 Aeritalia Turin (Italy)
A PARAMETRIC STUDY OF WING STORE FLUTTER
L Chesta *In* AGARD Specialists Meeting on Wing-With-Stores Flutter Apr 1975 12 p refs

The influence of different parameters on the flutter of wings with stores was studied in more than 3000 wind tunnel configurations The parameters studied include store mass, store radius of inertia store c g , pylon pitch stiffness, and wing sweep angle Results indicate (1) Flutter is induced by the coupling of the wing fundamental bending and the store pitch modes (2) Flutter speed decreases with increasing store radius of inertia until the frequency of the store pitch mode is higher than that of the fundamental bending (3) For all sweep angles the forward c g shifting produces a slight reduction of the minimum flutter speed , F O S

N75-28019 Grumman Aerospace Corp Bethpage N Y
RECENT OBSERVATIONS ON EXTERNAL-STORE FLUTTER
Eugene F Baird and William B Clark *In* AGARD Specialists Meeting on Wing-With-Stores Flutter Apr 1975 8 p refs

The problem of wing flutter with external stores is discussed in terms of flutter-prevention when designing aircraft General guidelines for the optimum arrangement of external stores on wings are given, and the mission-loading requirements for a new aircraft are considered Other topics discussed include pylons flutter-model tests ground vibration tests and flight-flutter tests F O S

N75-28020 Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
RECENT ANALYSIS METHODS FOR WING-STORE FLUTTER
Walter J Mykytow *In* AGARD Specialists Meeting on Wing-With-Stores Flutter Apr 1975 15 p refs

A summary of a brief review for some of the literature on the practical aspects of wing-store flutter prediction and prevention Brief comments are given on the advantages and disadvantages of various aspects of analytical and test procedures Descriptions of improved analytical procedures developed for the United States Air Force is then given Two methods are described in some detail and the results of the investigators are outlined One is a rapid special purpose wing-store flutter analysis program called FACES It has data storage and retrieval capabilities which together with a diagnostic and interpolation/extrapolation procedure estimate the flutter speed of new similar stores The system can be coupled to a cathode ray tube to increase man/machine interaction and reduce decision times The other analysis method described is based on the perturbation approach Computation times can be reduced 90% by using the previously available data The method produces good results when the mass or stiffness changes are small so that in turn, eigenvalue and eigenvector changes are small A graph of flutter speed versus important parameters can be produced in one minute on a modern computer Author

N75-28021*# Old Dominion Univ Research Foundation Norfolk, Va School of Engineering
ANALYTICAL SIMULATION OF THE FAR-FIELD JET NOISE AND THE UNSTEADY JET FLOW-FIELD BY A MODEL OF PERIODIC SHEDDING OF VORTEX RING FROM THE JET EXIT Final Technical Report
Chen-Huei Liu Aug 1975 4 p
(Grant NsG-1144)
(NASA-CR-143211 TR-75-T10) Avail NTIS HC $3 25 CSCL 01A

The construction of a theoretical flow field due to shedding of vortex rings the identification of the controlling parameters, and the determination of whether the theoretical model successfully simulated the unsteady pressure field near jet (and consequently the far field noise) was studied The basic parameters contained in the analytic solutions were the epoch at which a vortex ring was shed near the jet exit and the eddy viscosity coefficient These parameters were identified from the experimental data for the real-time pressure and from the spread of the mixing layer of the jet Results of the theoretical analysis show good qualitative agreement with the experimental data Author

N75-28024*# Georgia Inst of Tech Atlanta
OPTIMUM PERFORMANCE AND POTENTIAL FLOW FIELD OF HOVERING ROTORS Final Report
J C Wu and R K Sigman May 1975 95 p refs Sponsored in part by Army Air Mobility R and D Lab Moffett Field Calif
(Contract NAS2-6340)
(NASA-CR-137705) Avail NTIS HC $4 75 CSCL 01A

Rotor and propeller performance and induced potential flowfields were studied on the basis of a rotating actuator disk concept with special emphasis on rotors hovering out of ground effect A new theory for the optimum performance of rotors hovering OGE is developed and presented An extended theory for the optimum performance of rotors and propellers in axial motion is also presented Numerical results are presented for the optimum distributions of blade-bound circulation together with axial inflow and ultimate wake velocities for the hovering rotor over the range of thrust coefficient of interest in rotorcraft applications Shapes of the stream tubes and of the velocities in the slipstream are obtained, using available methods, for optimum and off-optimum circulation distributions for rotors hovering in and out of ground effect A number of explicit formulae useful in computing rotor and propeller induced flows are presented for stream functions and velocities due to distributions of circular vortices over axi-symmetric surfaces Author

N75-28026*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LOW-SPEED UPWASH INTERFERENCE ON A TRANSPORT MODEL IN A RECTANGULAR SLOTTED-WALL WIND TUNNEL
Michael J Mann Washington Aug 1975 25 p refs
(NASA-TM-X-3218 L-10042) Avail NTIS HC $3 25 CSCL 01A

A study was made of the upwash interference caused by the wind tunnel walls at a Mach number of 0 20 The wind tunnel has slotted horizontal walls and solid vertical walls and the wind tunnel model is a wing-fuselage combination typical of a short take-off and landing (STOL) transport Measurements were made of the model forces and angle of attack The experimental results are compared to theoretical solutions for the upwash interference This comparison enabled an indirect determination of one of the constants in the slotted wall boundary condition The magnitude of the experimental upwash interference is also compared to the accuracy of the data This comparison indicates that it is difficult to make definite conclusions based on the experimental data Suggestions are made for future research which could provide a practical means of accurately determining the wall-interference velocities in wind tunnels with rigid slotted walls Author

N75-28027*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EFFECT OF VERTICAL-TAIL LOCATION ON THE AERODYNAMIC CHARACTERISTICS AT SUBSONIC SPEEDS OF A CLOSE-COUPLED CANARD CONFIGURATION
Jarrett K Huffman Washington Aug 1975 49 p refs
(NASA-TN-D-7947 L-9961) Avail NTIS HC $3 75 CSCL 01A

The effects were studied of various vertical-tail configurations on the longitudinal and lateral directional-stability characteristics of a general research fighter model utilizing wing-body-canard The study indicates that the addition of the high canard resulted in an increase in total lift at angles of attack above 4 deg with a maximum lift coefficient about twice as large as that for the wing-body configuration For the wing-body (canard off) configuration the center-line vertical tail indicates positive vertical-tail effectiveness throughout the test angle-of-attack range however, for this configuration none of the wing-mounted vertical-tail locations tested resulted in a positive directional-stability increment at the higher angles of attack For the wing-body-canard configuration several outboard locations of the wing-mounted vertical tails were found Author

N75-28029*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
PRESSURE DISTRIBUTIONS ON A CAMBERED WING BODY CONFIGURATION AT SUBSONIC MACH NUMBERS
William P Henderson Washington Jul 1975 151 p refs
(NASA-TN-D-7946 L-10105) Avail NTIS HC $6 25 CSCL 01A

An investigation was conducted in the Langley high-speed 7- by 10-foot tunnel at Mach numbers of 0 20 and 0 40 and angles of attack up to about 22 deg to measure the pressure distributions on two cambered-wing configurations The wings had the same planform (aspect ratio of 2 5 and a leading-edge-sweep angle of 44 deg) but differed in amounts of camber and twist (wing design lift coefficient of 0 35 and 0 70) The effects of wing strake on the wing pressure distributions were also studied The results indicate that the experimental chordwise *pressure distribution agrees reasonably well with the design* distribution over the forward 60 percent of nearly all the airfoil sections for the lower cambered wing The measured lifting pressures are slightly less than the design pressures over the aft part of the airfoil For the highly cambered wing there is a significant difference between the experimental and the design pressure level The experimental distribution however is still very similar to the prescribed distribution At angles of attack above 12 deg the addition of a wing-fuselage strake results in a significant increase in lifting pressure coefficient at all wing stations outboard of the strake-wing intersection Author

N75-28030*# Lockheed-Georgia Co Marietta
CALCULATION OF UNSTEADY TRANSONIC AERODYNAMICS FOR OSCILLATING WINGS WITH THICKNESS
S Y Ruo and J G Theisen Washington NASA Aug 1975 53 p refs
(Contract NAS1-11156)
(NASA-CR-2259 LG74ER0129) Avail NTIS HC $4 25 CSCL 01A

An analytical approach is presented to account for some of the nonlinear characteristics of the transonic flow equation for finite thickness wings undergoing harmonic oscillation at sonic flight speed in an inviscid shock-free fluid The thickness effect is accounted for in the analysis through use of the steady local Mach number distribution over the wing at its mean position by employing the local linearization concept and a coordinate transformation Computed results are compared with that of the linearized theory and experiments Based on the local linearization concept, an alternate formulation avoiding the limitations of the coordinate transformation method is presented Author

N75-28031# Aeronautical Research Council, London (England)
ON THE APPLICATION OF SUBSONIC LINEARISED WING THEORY TO SECOND-ORDER FORCES AND MOMENTS
1975 67 p refs Supersedes ARC-34689 RAE-TR-73030 ARC-34-707
(ARC-R/M-3758 ARC-34689 RAE-TR-7303 ARC-34707) Avail NTIS HC $4 25 HMSO £3 50 PHI $13 45

Approaches to the evaluation of the second order aerodynamic side force and yawing moment on lifting wings are given in terms of the role of leading edge and side edge forces

N75-28032 Queen Mary Coll London (England)
GENERAL PRINCIPLES AND MATHEMATICAL MODELS
G J Hancock *In* Aeron Res Council On the Appl of Subsonic Linearised Wing Theory to Second-Order Forces and Moments 1975 p 5-32 refs
Copyright

The mathematical formulation of linearized finite wing theory in low speed steady flow is introduced and discussed The lifting surface model in which the vorticity is placed on a planar surface, is shown to lead to inconsistent results Consistent results are obtained when the vorticity is placed on the camber surface analysis involving the Trefftz plane the side force and yawing moment are derived from approximate expressions which avoid calculation of any edge forces Author (ESRO)

N75-28033 Royal Aircraft Establishment, Farnborough (England)
EDGE FORCES AND ROLL-RATE DERIVATIVES
H C Garner *In* Aeron Res Council On the Appl of Subsonic Linearised Wing Theory to Second-Order Forces and Moments 1975 p 33-65 refs
Copyright

The analysis of linearized subsonic lifting surface theory is extended to provide expressions for the leading edge and side edge forces The side force and yawing moment under conditions of asymmetric spanwise loading are obtained as the sum of three contributions normal pressures leading edge suction and tip suction These quantities are used to treat lifting wings in roll General trends in the theoretical derivatives are observed The related evidence from experiment and from semi-empirical methods is discussed and one such method is transcribed for use in conjunction with the theoretical computations Much of the nonlinear experimental behavior of the side force and yawing moment due to rate of roll can be accounted for by the removal of an increasing proportion of the theoretical edge forces as the lift increases Author (ESRO)

N75-28038# Army Foreign Science and Technology Center Charlottesville, Va
VORTEX WAKE BEHIND A HELICOPTER
A Larin 16 Jun 1974 10 p Transl into ENGLISH from Aviat Kosmonavt (USSR) v 3 1973 p 32-33
(AD-A005479 FSTC-HT-23-0317-74) Avail NTIS CSCL 01/3

Research into the vortex wake behind a helicopter was recently carried out It was found that vortex chords and cores created behind a helicopter are complex structures and are quite stable The phenomenon of secondary vortex generation was studied on a model with various numbers of blades GRA

N75-28040# Army Missile Research Development and Engineering Lab Redstone Arsenal, Ala Aeroballistics Directorate

THE AERODYNAMIC CHARACTERISTICS OF WRAP-AROUND FINS, INCLUDING FOLD ANGLE AT MACH NUMBERS FROM 0 5 TO 3 0

C Wayne Dahlke and Lewis D Flowers 15 Nov 1974 367 p

(DA Proj 1M2-62303-A-214)

(AD-A005574 RD-75-15) Avail NTIS CSCL 16/4

An experimental investigation was conducted in the McDonnell Douglas Aerophysics Laboratory 4-foot trisonic wind tunnel to study the aerodynamic characteristics of wrap around fins Wrap around fins with leading edge sweep angle and exposed semi-span variations were tested One unswept fin was tested simulating various opening angles from 10 degrees beyond fully open to a folding angle of 112 5 degrees Force and moment data were obtained at Mach Numbers from 0 5 to 3 0 at angles of attack up to 14 degrees and roll angles from 0 to 45 degrees The complete results of this test are presented in plotted form for the main balance and all four fin balances GRA

N75-28041# Virginia Polytechnic Inst and State Univ Blacksburg Dept of Aerospace and Ocean Engineering

ANALYTIC INVESTIGATION OF TRANSONIC NORMAL SHOCK BOUNDARY LAYER INTERACTION

W H Mason and G R Inger 1974 275 p refs

(Contract N00014-72-A-0136-0001 NR Proj 061-197)

(AD-A004980, VPI-Aero-027) Avail NTIS CSCL 01/1

Advances in inviscid transonic flow field computational capability and supercritical airfoil design make it important to understand the physics of normal shock-boundary layer interactions In this work the Navier-Stokes equations are thoroughly investigated through the use of perturbation methods and a generalized multi-region model is proposed for interactions between weak normal shock waves and turbulent boundary layers This model is first applied to a highly idealized case in which a uniform subsonic flow is used to model the boundary layer, and analytic results for the wall and interface pressure are obtained GRA

N75-28042# Chrysler Corp New Orleans La Data Management Services

TRANSONIC WIND TUNNEL INVESTIGATION OF THRUST EFFECTS ON THE LONGITUDINAL STABILITY CHARACTERISTICS OF SEVERAL BODY-FIN CONFIGURATIONS (STING-MOUNTED MODEL WITH NORMAL-JET PLUME SIMULATOR)

J H Henderson 31 Dec 1974 438 p refs

(Contract DAAH03-74-C-0405, DA Proj 1M2-62303-A-214)

(AD-A005152, DMS-AR-1021 RD-75-14) Avail NTIS CSCL 19/7

Transonic wind tunnel tests were conducted on a sting-mounted model to determine thrust effects on longitudinal stability characteristics of several body-fin combinations The plume was simulated by cold air ejected from a series of sonic jets normal to the missile axis One fin configuration was tested at several longitudinal positions Adverse plume effects on stability were reduced by location of fins a distance forward of the base The test was conducted at the Calspan Corporations 8 foot Transonic Wind Tunnel at Mach numbers ranging from 0 4 to 1 25 Angles of attack ranged from -4 degrees to 12 degrees Data were also obtained at roll angles of 22 5 degrees and 45 degrees for one configuration GRA

N75-28043*# United Aircraft Corp Stratford Conn Sikorsky Aircraft Div

CONCEPTUAL DESIGN STUDY OF 1985 COMMERCIAL VTOL TRANSPORTS THAT UTILIZE ROTORS

N F K Kefford and C L Munch Washington NASA May 1975 130 p refs

(Contract NAS2-8079)

(NASA-CR-2532 SER-50891) Avail NTIS HC $5 75 CSCL 01C

Conceptual design studies of pure and compound helicopter commercial short-haul transport aircraft for initial fabrication in 1980 were performed to determine their technical and economic feasibility One-hundred-passenger configurations were optimized for minimum direct operating cost consistent with producibility and marketability with emphasis on proper account of mass properties performance and handling qualities adequacy, and suppression of internal and external noise The effect of external noise constraints was assessed, in terms of gross weight and direct operating cost for each aircraft Author

N75-28044*# Boeing Vertol Co Philadelphia Pa

CONCEPTUAL ENGINEERING DESIGN STUDIES OF 1985-ERA COMMERCIAL VTOL AND STOL TRANSPORTS THAT UTILIZE ROTORS Final Report

J P Magee, R D Clark, and C A Widdison Washington NASA May 1975 123 p refs

(Contract NAS2-8048)

(NASA-CR-2545 D210-10918-1) Avail NTIS HC $5 25 CSCL 01C

Conceptual design studies are summarized of tandem-rotor helicopter and tilt-rotor aircraft for a short haul transport mission in the 1985 time frame Vertical takeoff designs of both configurations are discussed and the impact of external noise criteria on the vehicle designs performance, and costs are shown A STOL design for the tilt-rotor configuration is reported and the effect of removing the vertical takeoff design constraints on the design parameters fuel economy, and operating cost is discussed Author

N75-28045*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

OPERATIONAL EXPERIENCES OF A COMMERCIAL HELICOPTER FLOWN IN A LARGE METROPOLITAN AREA

Daniel J DiCarlo Washington Aug 1975 18 p refs

(NASA-TN-D-8000, L-10149) Avail NTIS HC $3 25 CSCL 01C

A survey of commercial helicopter-operating experiences was conducted using a helicopter flight recorder in order to provide a basis for extending helicopter design and service-life criteria These data are representative of 182 flight hours accumulated during 1414 flights comprised of the separate legs of the total route structure employed The operating experiences are presented in terms of the time spent within different airspeed brackets, within the classifiable flight conditions of climb en route and descent at various rates of climb and descent, and at different rotor rotational speeds The results indicated that the helicopter spent a majority of the flight time at airspeeds either below 40 knots or above 100 knots Rates of climb and descent were concentrated at values below 5 1 m/s (1000 ft/min) particularly for higher airspeeds Normal acceleration experiences were low both in the total number and peak value realized, however, an extremely large number of pitch angular-velocity experiences were noted Rotor rotational speeds were normal with no occurrences above the upper red-line limit Author

N75-28049*# Lockheed-Georgia Co Marietta

APPLICATION OF ACTIVE CONTROLS TECHNOLOGY TO THE NASA JET STAR AIRPLANE Final Report

R H Lange J F Cahill M C Campion E S Bradley D G MacWilkinson and J W Phillips Washington NASA Jun 1975 206 p refs

(Contract NAS4-2121)

(NASA-CR-2561 H-868) Avail NTIS HC $7 25 CSCL 01C

The feasibility was studied of modifying a Jet Star airplane into a demonstrator of benefits to be achieved from incorporating active control concepts in the preliminary design of transport type aircraft Substantial benefits are shown in terms of fuel economy and community noise by virtue of reduction in induced

drag through use of a high aspect ratio wing which is made possible by a gust alleviation system An intermediate configuration was defined which helps to isolate the benefits produced by active controls technology from those due to other configuration variables Also an alternate configuration which incorporated composite structures, but not active controls technology was defined in order to compare the benefits of composite structures with those of active controls technology Author

N75-28050*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
THE INFLUENCE OF ENGINE/TRANSMISSION/GOVERNOR ON TILTING PROPROTOR AIRCRAFT DYNAMICS
Wayne Johnson Jun 1975 27 p refs Prepared in cooperation with Army Air Mobility R and D Lab Moffett Field Calif
(NASA-TM-X-62455) Avail NTIS HC $3 75 CSCL 01C

An analytical model is developed for the dynamics of a tilting proprotor aircraft engine and drive train including a rotor speed governor and interconnect shaft The dynamic stability of a proprotor and cantilever wing is calculated, including the engine-transmission-governor model It is concluded that the rotor behaves much as if windmilling as far as its dynamic behavior is concerned with some influence of the turboshaft engine inertia and damping The interconnect shaft has a significant influence on the antisymmetric dynamics of proprotor aircraft The proprotor aerodynamics model is extended to include reverse flow and a refinement on the method used to calculate the kinematic pitch-bending coupling of the blade is developed Author

N75-28051# General Dynamics/Convair San Diego Calif Aerospace Div
WEAPON SYSTEM COSTING METHODOLOGY FOR AIRCRAFT AIRFRAMES AND BASIC STRUCTURES VOLUME 2 SUPPORTING DESIGN SYNTHESIS PROGRAMS Technical Report, Jul 1972 - Dec 1973
R E Kenyon Sep 1974 73 p refs
(AF Proj 1368)
(AD-A005426 AFFDL-TR-73-129-Vol-2) Avail NTIS CSCL 01/3

This volume describes the supporting programs used in conjunction with a cost estimating program to provide a trade study cost estimating technique for aerodynamic surfaces The supporting programs for the purpose of this discussion are defined as a structural synthesis program and a secondary structure synthesis program The structural synthesis program is used for the analysis of primary structure and is called APAS (Automated Program for Aerospace-Vehicle Synthesis) The secondary structure synthesis program estimates geometry and weights and performs parts definition for the aerodynamic surface leading edge trailing edge and tip components The cost estimating adaptation is derived from programs originally developed under Independent research and development GRA

N75-28052# Northrop Corp Hawthorne Calif Aircraft Div
FLIGHT SIMULATION OF THE MODEL 347 ADVANCED TANDEM-ROTOR HELICOPTER Final Report, Jul 1972 - Oct 1973
Don F Kesler Allen Y Murakoshi and John B Sinacori Nov 1974 66 p
(Contract DAAJ02-72-C-0112 DA Proj 1F1-63204-D-157)
(AD-A005050 NOR-73-190 USAAMRDL-TR-74-21) Avail NTIS CSCL 01/3

The basic purpose of the study was to define important flight control system design and handling qualities criteria for moving loads along beneath tandem-rotor heavy lift helicopters The principal study effort involved flight simulation of the Model 347 advanced tandem-rotor helicopter Methodologies used in developing data included theoretical analyses acquisition and evaluation of wind tunnel and flight test data derivation of motion equations analysis of sling load carrying problems development of the dynamics of a container slung beneath a tandem-rotor helicopter and the actual flight simulation of a Model 347 helicopter with external loads using Northrop s advanced large-amplitude moving-base simulator and its associated hybrid computers GRA

N75-28053# Honeywell Inc Minneapolis Minn Systems and Research Center
APPLICATION OF STEEP ANGLE APPROACH IN AN ENGINEERING AND FLIGHT TEST PROGRAM Final Report, Jun 1972 - Sep 1974
James W Wingert Oct 1974 120 p
(Contract N00014-72-C-0498 NR Proj 213-109)
(AD-A005074 JANAIR-741002) Avail NTIS CSCL 01/2

This study is part of the Army program whose overall objectives are to determine the adequacy of the MLS guidance signals required for integration with state-of-the-art displays to enable safe controlled decelerating steep angle approaches and landings to be made by helicopters and to provide display hardware suitable for integration with the MLS Army prototype evaluation The objective of this particular study is to apply the results of the previous JANAIR Steep Angle Approach and Landing study tasks which have been analytic and simulation efforts to a flight test of concepts principles and mechanization GRA

N75-28054# Boeing Vertol Co Philadelphia Pa
CRASHWORTHY HELICOPTER GUNNER'S SEAT INVESTIGATION Final Report
Mason J Reilly Jan 1975 255 p refs
(Contract DAAJ02-73-C-0021 DA Proj 1F2-62209-AH-76)
(AD-A005563 D210-10840-1 USAAMRDL-TR-74-98) Avail NTIS CSCL 01/3

The poor crash-impact performance of seats designed to current military specifications was revealed by the U S Army in the early 1960 s It was discovered that numerous seat occupants were being injured during moderate impacts because of inadequate upper torso restraint inadequate seat strength, absence of any meaningful vertical crash-force attenuation, and inadequate testing criteria Following extensive design and testing efforts improved crashworthiness design and testing criteria were developed for Army aircraft seating systems GRA

N75-28055# Kaman Aerospace Corp Bloomfield, Conn
FAN-IN-FUSELAGE ADVANCED ANTITORQUE SYSTEM Final Report, 9 Feb 1973 - 31 Jan 1974
Carroll R Akeley and George W Carson Nov 1974 101 p refs
(Contract DAAJ02-73-C-0033 DA Proj 1F1-62204-AA-44)
(AD-A005049 USAAMRDL-TR-74-89) Avail NTIS CSCL 01/3

The information contained in this report is a result of study analysis and design conducted to determine the performance of a helicopter with a fan-in-fuselage antitorque and yaw control system as compared with the performance of the same basic helicopter with a tail rotor GRA

N75-28056# General Dynamics/Fort Worth Tex
PROPOSED MIL-STD-XXX AIRCRAFT NONNUCLEAR SURVIVABILITY/VULNERABILITY TERMS
Dec 1974 177 p Sponsored in part by Navy
(Contract F33615-73-C-3150)
(AD-A004972 JTCG/AS-74-D-002) Avail NTIS CSCL 01/3

This document established standard definitions for aircraft non-nuclear S/V (survivability/vulnerability) terms so communication problems that have confronted S/V practitioners and workers in allied disciplines in government agencies and industry can be resolved The terms and definitions contained herein shall be used as applicable in all Department of Defense studies reports statements-of-work and other documentation involving nonnuclear aircraft S/V GRA

N75-28057# Army Aviation Systems Command St Louis Mo
MAJOR ITEM SPECIAL STUDY (MISS), UH-1H MAIN ROTOR HUB ASSEMBLY Interim Report, Jan 1964 - Dec 1973
Jan 1975 21 p
(AD-A005217 USAAVSCOM-TR-74-54) Avail NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA Form 2410 reportable components These are time change items and certain condition change items selected because of high cost or need for intensive management Basically, the MISS

reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency (MIRF) report The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting From this data removal distribution can be plotted and an MTR (mean time to removal) can be calculated The MISS reports then investigate possible cost savings based on total elimination of selected failure modes These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program (PIP) areas GRA

N75-28058# Army Aviation Engineering Flight Activity Edwards AFB Calif
ARMY PRELIMINARY EVALUATION 1 RV-1D/QUICK LOOK 2 AIRCRAFT Final report
Gary L Bender and James C OConnor Aug 1974 26 p refs
(AD-A005220 USAAEFA-74-36) Avail NTIS CSCL 01/3

The United States Army Aviation Engineering Flight Activity conducted a limited handling qualities evaluation of the RV-1D/Quick Look II aircraft manufactured by Grumman Aerospace Corporation The aircraft was tested at the Grumman facility in Stuart Florida on 16 and 17 July 1974 Testing included stability and control and miscellaneous engineering tests necessary to verify the flight envelope No deficiencies were found during these tests Two shortcomings were identified inadequate stall warning in the power-approach and landing configurations and the degraded single-engine performance and maneuvering capability caused by the inability to jettison the Quick Look II antenna pods GRA

N75-28059# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
A DESIGN STUDY FOR A REMOTELY PILOTED VEHICLE, AUTOMATIC LANDING SYSTEM M S Thesis
Mark P Hadley Dec 1974 111 p refs
(AD-A005285 GE/MA/74D-4) Avail NTIS CSCL 01/3

A method of control design is developed using optimal control theory which results in a simple and practical control system The basis of this method is the elimination of unnecessary feedback gains which in turn allows most of the Kalman filter elements to be eliminated also The procedure is developed by designing an automatic control system for a remotely piloted vehicle The aircraft modeled in the study was the Ryan Compass Cope RPV This aircraft has a low wing loading making it very susceptible to wind gusts The problem is limited to the approach phase of landing under moderate to severe turbulence Both longitudinal and lateral control systems are considered GRA

N75-28060# Douglas Aircraft Co Inc Long Beach Calif
ANALYTICAL INVESTIGATION OF MEDIUM STOL TRANSPORT STRUCTURAL CONCEPTS VOLUME 1 STUDY RESULTS Final Report, 15 Mar 1973 - 24 Jun 1974
R E Adkisson and G V Deneff Aug 1974 454 p refs 2 Vol
(Contract F33615-73-C-3049 AF Proj 1368)
(AD-A005818 MDC-J6625-Vol-1 AFFDL-TR-74-109-Vol-1) Avail NTIS CSCL 01/3

Results of a study program to devise and evaluate new structural concepts of lower weight and cost for a medium STOL transport aircraft are presented The wing box fuselage shell and empennage stabilizer structure of the projected C-15 production airplane were designated as the study (and baseline) components Selected concepts are evaluated for structural integrity weight manufacturing methods applicability of NDI methods production and life cycle costs and aircraft performance payoffs Structural integrity analyses of both the baseline and new concepts are based on a common set of requirements for ultimate strength fatigue life damage tolerance and flutter rigidity GRA

N75-28061# Douglas Aircraft Co Inc Long Beach Calif
ANALYTICAL INVESTIGATION OF MEDIUM STOL TRANSPORT STRUCTURAL CONCEPTS VOLUME 2 ISOGRAD FUSELAGE STUDY Final Report, 15 Mar 1973 - 24 Jun 1974
R E Adkisson G V Deneff, B J Alperin R L Zwart and M L Platte Aug 1974 118 p refs 2 Vol
(Contract F33615-73-C-3049 AF Proj 1368)
(AD-A006157 MDC-J6625-Vol-2 AFFDL-TR-74-109-Vol-2) Avail NTIS CSCL 01/3

Results of a study program to evaluate application of the isogrid structure concept to a medium STOL transport aircraft are presented Isogrid is an integrally stiffened panel concept incorporating a triangular arrangement of the stiffening material which has been used successfully on space vehicle structure The fuselage shell structure of the projected C-15 production airplane is used as the study and baseline component The isogrid concept is evaluated for structural concepts are based on a common set of requirements for ultimate strength fatigue and damage tolerance Because of generally lower stress levels and a general absence of rivet and bolt holes in basis isogrid structure fatigue and damage tolerance are of reduced criticality relative to baseline structure GRA

N75-28062 Syracuse Univ N Y
NOISE ABATEMENT BY THE INTERACTION OF COLD *COAXIAL MODEL JETS* Ph D Thesis
Mahmound Salim Audi 1974 252 p
Avail Univ Microfilms Order No 75-13958

The possibility of attenuation of noise from jets by inducing interaction between coaxial cold streams is assessed These streams discharge from two or three nozzles of an assembly of three convergent nozzles whose exits are coplanar The innermost nozzle is circular while the intermediate and the outermost are annular and all have the same exit area of 1104 sq in The two interacting jets investigated here discharge from the innermost and the intermediate nozzles while the three interacting jets discharge from the three nozzles of the assembly Throughout almost all of the investigation the reservoir pressure of the intermediate jet was maintained at 30 psig while the innermost jet reservoir pressure and the outermost jet reservoir pressure are varied systematically from 0 to 30 psig increments The data gathered for this research includes both shadowgraphic records and far field noise surveys Dissert Abstr

N75-28063 British Library Lending Div Boston Spa (England)
THE LIGHT INDUSTRIAL GAS TURBINE PAST AND FUTURE
M A W Stratemeier 14 May 1974 24 p Transl into ENGLISH from a German report
(BLL-CE-Trans-6395-(9022 09)) Avail British Library Lending Div Boston Spa, Engl 3 BLL photocopy coupons

Application of the gas turbine engine to the generation of electricity is considered Industrial operation of the gas turbine is compared to that of the aircraft engine Technical modifications are described J M S

N75-28065# Defence and Civil Inst of Environmental Medicine Downsview (Ontario) Behavioural Sciences Div
NOISE LEVELS IN THE CC-109, CC-115, AND CC-117 AIRCRAFT
S E Forshaw, R A Stong and R B Crabtree Sep 1974 18 p refs
(DCIEM-74-R-1059) Avail NTIS HC $3 25

The results of noise surveys in the CC-109 CC-115 and CC-117 aircraft, are reported and the effectiveness of current CF headsets in minimizing the risk of noise-induced hearing loss among the crews of these aircraft, was discussed The H-157/AIC headset provides adequate protection for the crew of the CC-109 aircraft and for the pilots of the CC-115 aircraft The navigator of the CC-115 however is located in an extremely noisy area of the aircraft and requires the added low frequency protection provided by the NX-10 headset Pilots of the CC-117 aircraft do not require hearing protection and may prefer therefore, to wear a more comfortable headset such as the Airlite 71 Author

N75-28066*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
INTERIOR NOISE LEVELS OF TWO PROPELLER-DRIVEN LIGHT AIRCRAFT

John J Catherines and William H Mayes Jul 1975 21 p refs
(NASA-TM-X-72716) Avail NTIS HC $3 25 CSCL 20A

The relationships between aircraft operating conditions and interior noise and the degree to which ground testing can be used in lieu of flight testing for performing interior noise research were studied The results show that the noise inside light aircraft is strongly influenced by the rotational speed of the engine and propeller Both the overall noise and low frequency spectra levels were observed to decrease with increasing high speed rpm operations during flight This phenomenon and its significance is not presently understood Comparison of spectra obtained in flight with spectra obtained on the ground suggests that identification of frequency components and relative amplitude of propeller and engine noise sources may be evaluated on stationary aircraft
Author

N75-28069*# Flow Research, Inc , Kent Wash
NUMERICAL SIMULATION OF TURBULENT JET NOISE, PART 1
Ralph W Metcalfe and Steven A Orszag [1975] 75 p refs (Contract NAS1-12870)
(NASA-CR-132693 Rept-53) Avail NTIS HC $4 25 CSCL 20A

Flow characteristics, such as quadrupole moments are examined in order to study generation of aerodynamic noise The mean flow quantities are set in accordance with experimental data and the incompressible Navier-Stokes are solved numerically Isolated downstream sections of a turbulent jet are modelled separately with the mean flow characteristics held constant in time The flows are allowed to evolve until the fluctuating velocity components reach a statistically steady state Cross section contour plots of the velocity components and the quadrupole moments at three different downstream positions are presented
Author

N75-28137 Maryland Univ , College Park
DIVERGENCE ELIMINATION WITH ADVANCED COMPOSITES Ph D Thesis
Norris Jacob Krone, Jr 1974 120 p
Avail Univ Microfilms Order No 75-14306

The ability to tailor material properties to suit a particular loading situation was studied The structural characteristics of an airfoil and elimination of the structural weight penalty normally associated with divergence prevention for swept-forward airfoils, and a comparison using aluminum and composite wing designs of various sweep angles is presented The optimization of each design to determine the minimum weight necessary to satisfy the loading condition and the divergence criteria imposed was also studied The results of the study show the undesirability of using swept-forward wing designs which incorporate isotropic materials, and in marked contrast with its aluminum counterpart the composite structural weight variation with forward sweep is not found to be significant Dissert Abstr

N75-28139 Rensselaer Polytechnic Inst Troy, N Y
DEVELOPMENT AND EVALUATION OF HIGH-ENERGY BRAKE MATERIALS Ph D Thesis
Ting-Long Ho 1974 132 p
Avail Univ Microfilms Order No 75-14943

An investigation was carried out to study and develop high temperature aircraft brake materials sliding against 17-22 AS steel The requirements of brake materials were outlined and a survey made to select materials to meet these requirements Based upon their physical and thermal properties, a number of metals and ceramic materials were selected and evaluated in sliding tests which simulated aircraft braking These were nickel, molybdenum tungsten ZrO2 high temperature cements and carbons Additives were then incorporated into these materials to optimize their wear or strength behavior with particular emphasis on nickel and molybdenum base materials and a high temperature potassium silicate cement Optimum materials were developed which had improved wear behavior over conventional brake materials in the simulated test Dissert Abstr

N75-28193 Drexel Univ , Philadelphia, Pa
FORGING OF METAL-MATRIX COMPOSITES FORMING LIMIT CRITERIA AND APPLICATIONS TO PROCESS DESIGN Ph D Thesis
R Turgay Ertuerk 1975 132 p
Avail Univ Microfilms Order No 75-14402

Fundamental deformation and fracture behavior of fiber-reinforced metal-matrix composites were determined under conditions of simulated forging Defects that occur during the forging of a sample material (2024 Al-alloy matrix reinforced with 25 v/o stainless steel wires) are characterized and criteria for their prediction and prevention established These forming limit criteria, in combination with an analysis of metal flow during deformation processing, were used to develop a forging process for an airfoil shape The design method developed based on the forming limit criteria, demonstrates a rational approach to the design of processes for forging complex shapes from composite materials Utilizing this approach, process parameters (die and preform geometry lubrication) can be evaluated for forging sound complex composite shapes Dissert Abstr

N75-28236# Army Engineer Waterways Experiment Station Vicksburg Miss
EVALUATION OF EXPERIMENTAL POLYURETHANE-COATED MEMBRANES Final Report
Timothy W Vollor Jan 1975 68 p refs
(DA Proj 1T0-62103-A-046)
(AD-A005151 AEWES-TR-S-75-1) Avail NTIS CSCL 13/3

This report describes an investigation conducted for the development of an improved flexible prefabricated membrane surfacing suitable as an expedient dustproofing and waterproofing medium for soil subgrades used as forward-area airfields and road surfacings This was accomplished by means of laboratory tests of PUC membranes adhesives, and nonskid compounds to determine physical properties, and skid tests simulating C-130 braking action on nonskidcoated PUC membranes placed on a soil subgrade to determine skid resistance and durability GRA

N75-28243# Whittaker Corp San Diego Calif Research and Development Div
INVESTIGATION OF REINFORCED PLASTICS FOR NAVAL AIRCRAFT ELECTROMAGNETIC (EM) WINDOWS Final Report, Aug 1973 - Oct 1974
Vance A Chase Jan 1975 92 p refs
(Contract N00019-74-C-0055)
(AD-A005170, MJO-3043) Avail NTIS CSCL 11/9

Polymer and fiber materials for naval radome applications were investigated The investigation was concerned with materials having low and stable dielectric constant and loss tangent properties Primary emphasis was on polybutadiene polymers, with various other classes of polymers including thermoplastics being investigated as secondary candidates A survey was conducted on the availability of polybutadiene polymers and a characterization study performed on 14 different resins from three manufacturers Secondary resin candidates which included polysulfones, polyimides polyphenylquinoxalines, and polyamide-imides, were evaluated Composite processing studies were conducted for the more promising resin candidate materials Investigations were conducted into fiber finishes and surface treatments compatible with the polybutadiene resin for both fiber reinforcements GRA

N75-28244# Picatinny Arsenal Dover N J
COOPERATIVE PROGRAM FOR DESIGN, FABRICATION, AND TESTING OF GRAPHITE-EPOXY COMPOSITE HELICOPTER SHAFTING Progress Report
Charles C Wright, Donald J Baker L Thurston and R Clary Dec 1974 96 p refs
(DA Proj 1T1-62105-A-331)
(AD-A005024 PA-TR-4688, PR-2) Avail NTIS CSCL 11/4

A design methodology employing computer programs was developed and used to provide five designs of composite helicopter tail rotor drive shaft segments Shaft test specimens were fabricated from MODMOR I and CELION GY-70 graphite fiber reinforced epoxy resin Results from the laboratory testing of

these 18-inch (nominal) long specimens plus those from a previously fabricated THORNEL 50S specimen were used to compute performance expected from standard 57-inch (nominal shaft segments) All designs tested exceeded the minimum design requirements for stiffness fatigue life Vibration, and residual strength When the artificial constraints of windup and segment length were removed, the developed design methodology using a composite of 75 million psi modulus fiber and ERLB 4617 epoxy resin yielded a shaft train of only three segments These tubes were only 39% as heavy as their aluminum counterparts, the combined weight savings from lighter tubes and bearing assembly elimination due to longer shaft segments resulted in a 53 1% weight saving for the total shaft train if compared with the current 2024 aluminum shaft train GRA

N75-28278*# Ohio Univ Athens Avionics Engineering Center
COMMON ANTENNA PREAMPLIFIER-ISOLATOR FOR VLF-LF REGEIVERS
R W Burhans Jul 1975 6 p
(Grant NGR-36-009-017)
(NASA-CR-143237, TM-17) Avail NTIS HC $3 25 CSCL 17B

A modified high impedance preamplifier circuit which provides outputs to drive an Omega-VLF receiver and an ADF-LF receiver from a common antenna on general aviation aircraft is reported The preamplifier was evaluated with fixed ground station receivers and results show the burn out problem of the first stage MOSFET during very close lightning discharges was eliminated Author

N75-28394*# Physical Dynamics Inc Berkeley Calif
LASER DOPPLER VELOCIMETER SYSTEM SIMULATION FOR SENSING AIRCRAFT WAKE VORTICES PART 2 PROCESSING AND ANALYSIS OF LDV DATA (FOR RUNS 1023 AND 2023) Final Report
J C S Meng and J A L Thomson Feb 1975 88 p refs
(Contract NAS8-28984)
(NASA-CR-120758, PD-75-077-Pt-2) Avail NTIS HC $4 75 CSCL 14B

A data analysis program constructed to assess LDV system performance to validate the simulation model and to test various vortex location algorithms is presented Real or simulated Doppler spectra versus range and elevation is used and the spatial distributions of various spectral moments or other spectral characteristics are calculated and displayed Each of the real or simulated scans can be processed by one of three different procedures simple frequency or wavenumber filtering, matched filtering, and deconvolution filtering The final output is displayed as contour plots in an x-y coordinate system as well as in the form of vortex tracks deduced from the maxima of the processed data A detailed analysis of run number 1023 and run number 2023 is presented to demonstrate the data analysis procedure Vortex tracks and system range resolutions are compared with theoretical predictions Author

N75-28395*# Physical Dynamics, Inc Berkeley Calif
LASER DOPPLER VELOCIMETER SYSTEM SIMULATION FOR SENSING AIRCRAFT WAKE VORTICES PART 3 THE PROBLEM OF REFLECTION FROM THE SECONDARY MIRROR
J A L Thomson Mar 1975 28 p ref
(Contract NAS8-28984)
(NASA-CR-120759 PD-75-078-Pt-3) Avail NTIS HC $3 75 CSCL 14B

Calculations are carried out to investigate the effects of obscuring the central portion of the secondary mirror Two cases are treated (1) a Gaussian distribution of reflectivity and (2) a sharp-edged obscuration Substantial reduction in reflection from the secondary mirror is found achievable but the reduction was found highly sensitive to the form of the radial distribution of reflectivity The total power reflected from the secondary mirror that is incident on the detector is estimated Techniques for experimental testing of alleviation schemes are suggested Author

N75-28404# Army Aviation Systems Test Activity Edwards AFB, Calif
ICING TUNNEL TEST HOT-FILM ANEMOMETER Final Report
Paul R Bonin and Robert P Jefferis Feb 1974 26 p refs
(AD-A005044, USAASTA-73-04) Avail NTIS CSCL 14/2

A limited test is reported of a Thermo-Systems Inc series 1050 constant-temperature hot-film anemometer system in the Lockheed-California Company icing research tunnel to determine its suitability as a detector of discrete water droplets and liquid water content in natural and artificial icing clouds It was determined that the hot-film anemometer was capable of recording individual droplet encounters but that the signal processing equipment required modifications to prevent errors due to noise, saturation, and frequency response Recommendations include improved signal processing electronics and precautionary procedures to enhance anemometer survivability GRA

N75-28444# National Bureau of Standards Washington D C Mechanics Div
SHEAR AND TENSION-BENDING FATIGUE TEST METHODS FOR THREADED AIRFRAME FASTENERS Final Report
Daniel J Chwirut Donald E Marlowe and James S Steel Sep 1974 57 p refs
(COM-75-10417/4 NBSIR-74-465) Avail NTIS HC $4 25 CSCL 13E

Fatigue test methods for threaded airframe fasteners loaded in other than direct tension are described The types of loading considered are single shear double shear and tension-bending The test fixtures used in these tests are described Results of tests on fasteners from different manufacturers indicate that fasteners considered identical on the basis of direct tension procurement tests exhibit different fatigue life characteristics when loaded in shear and/or tension-bending The test methods described may be of future value as procurement tests for airframe fasteners GRA

N75-28533# Chrysler Corp New Orleans La Space Div
DEVELOPMENT OF AN AIRCRAFT BATTERY CONDITIONER/ANALYZER Final Report, 19 Jun 1972 - 18 Dec 1973
Dec 1974 43 p
(Contract DAAJ02-72-C-0108 DA Proj 1F1-62205-A-119)
(AD-A005055 USAAMRDL-TR-74-81) Avail NTIS CSCL 10/3

The report documents the development and evaluation of a prototype Programmed Peak Charges (PPC) battery conditioner/analyzer system for nickel-cadmium batteries It describes testing to determine the advantages of the unit as compared to constant-potential-charge systems The results show that the PPC system reduces water boiloff, reduces overtemperature conditions and has fewer battery recycles and cell replacements Use of the PPC system increases battery life, reduces maintenance, and eliminates hazards GRA

N75-28585 British Library Lending Div, Boston Spa (England)
AIRCRAFT INVESTIGATIONS OF THE MICROSTRUCTURE OF THE TEMPERATURE FIELDS IN THE TROPOSPHERE AND STRATOSPHERE
V P Baljaev [1974] 8 p Transl into ENGLISH of conf paper from Gidromet Inst Presented at All Union Conf on Problems Met Safety Supersonic Aviation, 24-26 Mar 1971 p 306-312
(BLL-M-23558-(5828 4F)) Avail British Library Lending Div, Boston Spa Engl 1 BLL photocopy coupon

Meteorological information for supersonic aircraft requires a knowledge of the temperature regime on all sections of the flight path (in the troposphere and in the lower stratosphere) Experimental data were obtained on the temperature of the air and its fluctuations from ground level up to heights of 20 to 25 km The automatic electrical thermometer for aircraft measures the mean temperature and its fluctuations from aircraft flying at subsonic speeds With a thermo-anemometer measurements were made of the fluctuations in air speed of the aircraft synchronously with temperature Author

N75-28632 British Library Lending Div Boston Spa (England)
ANALYSIS OF VISIBILITY CONDITIONS FOR AIRCRAFT LANDING IN RADIATION FOG
Ju G Konovalov and M Ja Racimor [1974] 7 p refs Transl into ENGLISH from Tr Gidromet Nauo Issled Cent SSSR (Leningrad) v 95 1972 p 3-8
(BLL-M-23561-(5828 4F)) Avail British Library Lending Div, Boston Spa Engl 1 BLL photocopy coupon

Basic models of the distribution of transparency in a radiation fog are discussed which include the following a decrease in optical density in the direction of the upper fog boundary, positioning of the layer of maximum optical density at some level above the earth s surface and an even distribution of optical density throughout the depth of the fog Visibility calculations are presented M J S

N75-28822*# Aerophysics Research Corp, Bellevue Wash
APPLICATION OF DIFFERENTIAL GAME THEORY TO ROLE-DETERMINATION IN AERIAL COMBAT
A W Merz Jul 1975 57 p refs
(Contract NAS2-8844)
(NASA-CR-137713) Avail NTIS HC $4 25 CSCL 12B

The development of criteria which specify the roles of pursuer and evader as functions of the relative geometry and of the important parameters of the problem are discussed A reduced-order model of the relative motion is derived and discussed In this model, the two aircraft move in the same plane at unequal but constant speeds, and with different maximum turn rates The equations of relative motion are of third order the dependent variables being the relative range bearing, and heading of the two aircraft Termination of the pursuit-evasion game is defined by either the heading-limited or the range-limited end condition These are geometric conditions for which the evading aircraft is in front of the other, with the relative heading and relative range satisfying certain inequalities Retrograde solutions to the equations of relative motion were used with the derived optimal terminal maneuvers to find where an assumed set of end conditions could have begun Author

N75-28849*# Boeing Co Wichita Kans
ACOUSTIC RADIATION FROM LINED, UNFLANGED DUCTS ACOUSTIC SOURCE DISTRIBUTION PROGRAM
R J Beckemeyer and D T Sawdy 12 Dec 1971 202 p refs
(Contract NAS3-14321)
(NASA-CR-120849 D3-8611-1) Avail NTIS HC $7 25 CSCL 20A

An acoustic radiation analysis was developed to predict the far-field characteristics of fan noise radiated from an acoustically lined unflanged duct This analysis is comprised of three modular digital computer programs which together provide a capability of accounting for the impedance mismatch at the duct exit plane Admissible duct configurations include circular or annular with or without an extended centerbody This variation in duct configurations provides a capability of modeling inlet and fan duct noise radiation The computer programs are described in detail Author

N75-28850*# Boeing Co Wichita Kans
ACOUSTIC RADIATION FROM LINED UNFLANGED DUCTS DIRECTIVITY INDEX PROGRAM
R J Beckemeyer and D T Sawdy 12 Dec 1971 67 p refs
(Contract NAS3-14321)
(NASA-CR-120850 D3-8611-2) Avail NTIS HC $4 25 CSCL 20A

For abstract see N75-28849

N75-28851*# Boeing Co, Wichita Kans
ACOUSTIC RADIATION FROM LINED, UNFLANGED DUCTS DUCT TERMINATION IMPEDANCE PROGRAM
R J Beckemeyer and D T Sawdy 12 Dec 1971 77 p refs
(Contract NAS3-14321)
(NASA-CR-120851 D3-8611-3) Avail NTIS HC $4 75 CSCL 20A

For abstract see N75-28849

N75-28875# Kaiser Aerospace and Electronics Corp Palo Alto Calif
FEASIBILITY STUDY FOR A DUAL FIELD OF VIEW-SINGLE DETECTOR ARRAY INFRARED SYSTEM Final Report
Jun 1974 89 p
(Contract DAAK02-72-C-0419)
(AD-A005658) Avail NTIS CSCL 17/5

An analytical study was conducted to determine the feasibility of multiplexing two infrared images gathered by two separate lens systems, at a coincident focal plane thereby permitting utilization of only one infrared detector array for time shared processing of both images The study was primarily directed towards determining the feasibility and practicality of, dual image opto-mechanical scanning techniques and retaining flicker-free video presentations by storing and processing the multiplexed IR video The results of the study show that the concept is feasible and that hardware can be implemented by using state-of-the-art techniques The investigation into scanning techniques and data storage media indicates that the most suitable hardware implementation would consist of a Collimated Dual Galvanometer Optical Scanner and a Storage Refresh Memory using MOS Shift Registers GRA

N75-28961# Air Force Materials Lab Wright-Patterson AFB Ohio
AIR FORCE TECHNICAL OBJECTIVE DOCUMENT, FISCAL YEAR 1975
Oct 1974 28 p
(AD-A005386 AFML-TR-74-270) Avail NTIS CSCL 05/2

This Technical Objective Document was prepared by the Air Force Materials Laboratory (AFML) and describes the Materials Technology Areas for meeting future Air Force operational needs The six Technology Areas encompass the full spectrum of materials capabilities required for future aircraft missile space and electronic systems - Thermal Protection Materials Aerospace Structural Materials Aerospace Propulsion Materials Fluid Lubricant and Elastomeric Materials, Protective Coatings and Materials and Electromagnetic Materials Presented for each TA is the general objective specific goals technical approaches and a Laboratory TA focal point who can facilitate face-to-face discussions with Laboratory engineers and scientists GRA

N75-29001*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
NASA/UNIVERSITY CONFERENCE ON AERONAUTICS
Washington 1975 430 p refs Conf held at Lawrence, Kans, 23-24 Oct 1974
(NASA-SP-372, L-10142, LC-75-600023) Avail NTIS HC $10 50 CSCL 01B

The proceedings of a conference on the future of aeronautics are presented The subjects discussed include the following (1) aeronautics and the education of the engineer, (2) technical trends in aeronautics, and (3) the role of the university in aeronautics The technical trends in aeronautics are concerned with aircraft noise control the effect of the aircraft on the environment, airborne electronics for automated flight and trends in aircraft design

N75-29002* National Aeronautics and Space Administration Washington D C
AERONAUTICS IN THE AMERICAN SOCIETY
James C Fletcher *In its* NASA/Univ Conf on Aeron 1975 p 1-10
CSCL 01B

The trends in aeronautics and aeronautical education are discussed with respect to the roles of industry government and the universities The importance of the aviation industry to the economy of the country is examined The impact of reduced enrollment of aeronautical engineering students in the universities on the future of the aeronautical industry is stressed It is stated that the role of the government should be to sponsor and conduct basic research and advanced technology programs for civil and military aviation and the specification development, procure-

ment, and operation of military aircraft Recommendations are made for approaches which may be taken to influence more qualified students to enter the field of aeronautics Author

N75-29007* Lockheed Aircraft Corp Sunnyvale, Calif
THE NEXT FORTY YEARS IN AVIATION
Willis M Hawkins *In* NASA Langley Res Center NASA/Univ Conf on Aeron 1975 p 71-102

CSCL 01B

A prediction of the status of various types of aviation activities which may be expected in twenty years is presented The basic assumptions are that the population of the nation will continue to grow at more than 7 percent and that the need for air transportation of passengers and cargo will increase accordingly Various predictions are also made for the developments in vertical takeoff aircraft, short haul airline operations, general aviation, and military aircraft Areas of improvement are indicated for air navigation, air traffic control, night vision, quiet aircraft, and the use of hydrogen as a fuel Author

N75-29008* National Aeronautics and Space Administration Langley Research Center Langley Station Va
TRENDS IN AIRCRAFT NOISE CONTROL
Harvey H Hubbard and Earl W Conrad *In its* NASA/Univ Conf on Aeron 1975 p 103-130 refs

CSCL 01C

Flight vehicles are characterized according to their manner of operation and type of propulsion system, and their associated sources of noise are identified Available noise reduction technology as it relates to engine cycle design and to powerplant component design is summarized Such components as exhaust jets, fans propellers, rotors, blown flaps, and reciprocating-engine exhausts are discussed, along with their noise reduction potentials Significant aircraft noise reductions are noted to have been accomplished by the application of available technology in support of noise certification rules Further noise reductions to meet more stringent future noise regulations will require substantial additional technology developments Improved analytical prediction methods, and well-controlled validation experiments supported by advanced-design aeroacoustic facilities, are required as a basis for an effective integrated systems approach to aircraft noise control Author

N75-29009* National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
ASSESSING AND CONTROLLING THE EFFECT OF AIRCRAFT ON THE ENVIRONMENT POLLUTION
I G Poppoff and J S Grobman *In its* NASA/Univ Conf on Aeron 1975 p 131-142
CSCL 13B

The air pollution created by aircraft engines around airports and the global atmospheric problem of supersonic aircraft operating in the stratosphere are discussed Methods for assessing the air pollution impact are proposed The use of atmospheric models to determine the air pollution extent is described Methods for controlling the emissions of aircraft engines are examined Diagrams of the atmospheric composition resulting from exhaust gas emissions are developed Author

N75-29010* National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
ON WAKE VORTEX ALLEVIATION
Leonard Roberts *In its* NASA/Univ Conf on Aeron 1975 p 143-168 refs
CSCL 01A

Research within NASA relating to the nature of lift-induced vortex wakes behind large aircraft and the means whereby the hazard they represent to smaller aircraft can be alleviated is reviewed The research, carried out in ground based facilities and in flight shows that more rapid dispersion of the wake can be effected by several means and that the modification of span-loading by appropriate flap deflection holds promise of early practical application Author

N75-29011* National Aeronautics and Space Administration Langley Research Center, Langley Station Va
AIRBORNE ELECTRONICS FOR AUTOMATED FLIGHT SYSTEMS
George B Graves, Jr *In its* NASA/Univ Conf on Aeron 1975 p 169-182 refs
CSCL 01D

The increasing importance of airborne electronics for use in automated flight systems is briefly reviewed with attention to both basic aircraft control functions and flight management systems for operational use The requirements for high levels of systems reliability are recognized Design techniques are discussed and the areas of control systems computing and communications are considered in terms of key technical problems and trends for their solution Author

N75-29012* National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
THE LONG TERM ENERGY PROBLEM AND AERONAUTICS
Richard A Rudey *In its* NASA/Univ Conf on Aeron 1975 p 183-210 refs
CSCL 10B

The projected increase in energy consumption by transportation in general and civil aviation in particular is directly opposed to the dwindling supplies of natural petroleum crude oil currently used to produce aircraft fuels This fact dictates the need to develop even more energy conservative aircraft and propulsion systems than are currently available and to explore the potential of alternative fuels to replace the current petroleum derived hydrocarbons Advances in technology are described in the areas of improved component efficiency, aircraft and engine integration, control systems, and advanced lightweight materials that are needed to maximize performance and minimize fuel usage Also, improved turbofan and unconventional engine cycles which can provide significant fuel usage reductions are described These advancements must be accomplished within expected environmental constraints such as noise and pollution limits Alternative fuels derived from oil shale and coal are described, and the possible technological advancements needed to use these fuels in aircraft engines are discussed and evaluated with relation to potential differences in fuel characteristics Author

N75-29014* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
SOME TRENDS IN AIRCRAFT DESIGN STRUCTURES

George W Brooks *In its* NASA/Univ Conf on Aeron 1975 p 213-272 refs
CSCL 01C

Trends and programs currently underway on the national scene to improve the structural interface in the aircraft design process are discussed The National Aeronautics and Space Administration shares a partnership with the educational and industrial community in the development of the tools, the criteria, and the data base essential to produce high-performance and cost-effective vehicles Several thrusts to build the technology in materials, structural concepts, analytical programs, and integrated design procedures essential for performing the trade-offs required to fashion competitive vehicles are presented The application of advanced fibrous composites, improved methods for structural analysis, and continued attention to important peripheral problems of aeroelastic and thermal stability are among the topics considered Author

N75-29015* National Aeronautics and Space Administration Flight Research Center, Edwards, Calif
STATUS AND TRENDS IN ACTIVE CONTROL TECHNOLOGY
Herman A Rediess and Kenneth J Szalai *In its* NASA/Univ Conf on Aeron 1975 p 273-322 refs

CSCL 01C

The emergence of highly reliable fly-by-wire flight control systems makes it possible to consider a strong reliance on

automatic control systems in the design optimization of future aircraft This design philosophy has been referred to as the control configured vehicle approach or the application of active control technology Several studies and flight tests sponsored by the Air Force and NASA have demonstrated the potential benefits of control configured vehicles and active control technology The present status and trends of active control technology are reviewed and the impact it will have on aircraft designs, design techniques, and the designer is predicted Author

N75-29016* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
OPPORTUNITIES FOR AERODYNAMIC-DRAG REDUCTION
Robert E Bower *In its* NASA/Univ Conf on Aeron 1975 p 323-352 refs
CSCL 01C

Methods for reducing aerodynamic drag to improve aircraft performance and reduce fuel consumption are discussed The techniques considered are (1) pressure drag reduction, (2) supercritical airfoils, (3) subcritical airfoils, (4) induced drag reduction by over-the-wing blowing and increased aspect ratio, and (5) friction drag reduction by laminar flow control and slot injection It is stated that a 50 percent reduction from current drag values is expected through the application of these techniques Author

N75-29021* Cessna Aircraft Co Wichita Kans
GENERAL AVIATION'S FUTURE NEED FOR RESEARCH
Malcolm Harned *In* NASA Langley Res Center NASA/Univ Conf on Aeron 1975 p 379-380

CSCL 01B

The research requirements for general aviation aircraft are presented Emphasis is placed on improving the performance of airfoils, propellers, and engines Additional requirements are expressed with respect to external noise reduction, internal noise reduction, and exhaust emission control The requirement for anti-icing developments to create improved flight safety is discussed Author

N75-29026# National Aerospace Lab Tokyo (Japan)
EFFECTS OF REYNOLDS NUMBER AND ROUGHNESS ON C SUB Lmax
Nobuhiko Kamiya Masayoshi Nakamura Tadashi Itoh Hirotaka Itabashi and Miyuki Nomura Dec 1974 12 p refs In JAPANESE, ENGLISH summary
(NAL-TR-396) Avail NTIS HC $3 25

Maximum lift coefficient is one of the aerodynamic characteristics of a wing which it is very difficult to estimate from experimental data It is observed in various experiments that C sub Lmax increases with increasing Reynolds number As Reynolds number increases the drag of a circular cylinder first decreases to a minimum value and then increases again to some constant value due to the corresponding movement of the separation point of the boundary layer C sub Lmax of an airfoil depends strongly on the location of the separation point, which is considered to move backward first and then forward as Reynolds number increases similarly to the case of the circular cylinder Therefore it may be considered that C sub Lmax increases first to a maximum value and then decreases In order to verify this presumption, a preliminary experiment was made in a simple experimental setup with a two dimensional model, composed of a circular cylinder and a flap of Thwaites type at Reynolds numbers ranging from 4 x 10 000 to 4 x 100,000 It is demonstrated that C sub Lmax of this model behaved as expected Author

N75-29027# National Aerospace Lab Tokyo (Japan)
MEASUREMENT AND ANALYSIS OF UNSTEADY AERODYNAMIC FORCE FOR THE VERTICAL GUST ON AN AIRPLANE MODEL IN THE NAL GUST WIND TUNNEL
Hiroshi Nishimura, Hiroshi Matsushita Kiyomi Kitamura, and Yoshitaka Murakami Jan 1975 16 p refs In JAPANESE, ENGLISH summary
(NAL-TR-399) Avail NTIS HC $3 25

A vertical gust aerodynamic force study in a gust wind tunnel which has a 2 meter squared section and gust generation cascades is reported Sinusoidal and random gusts of about 1 meter per sec vertical amplitude are applied on a semi rigid model of about 1 4 meter span fixed at the middle of the test section Longitudinal tunnel flow is fixed at 20 meter per sec and experimental frequencies are 0 2 to 10 Hz Parts of data are compared with theoretical calculation for tapered three dimensional wings Results show wing/body/tail interferences for the complete tailless and wingless configurations Author

N75-29028+ Engineering Sciences Data Unit London (England)
INFORMATION ON THE USE OF DATA ITEMS IN THE SERIES BODIES 02 04
Dec 1971 1 p
(ESDU-02 04 00) Copyright Avail NTIS HC $7 50

Data items (DI) for calculating the drag of streamline bodies at small angles of incidence are listed along with those DI which have information concerning the permissible limits of roughness inlaminar flow The DI which discusses the application of data dealing with drag increase due to roughness is also given Author

N75-29029+ Engineering Sciences Data Unit, London (England)
TRANSONIC DATA MEMORANDUM. SECOND-ORDER METHOD FOR ESTIMATING THE SUBCRITICAL PRESSURE DISTRIBUTION ON A TWO-DIMENSIONAL AEROFOIL IN COMPRESSIBLE INVISCID FLOW
Dec 1973 22 p refs
(ESDU-72025) Copyright Avail NTIS HC $122 50

A method is presented accurate to second-order in thickness, camber and incidence, for estimating the subcritical pressure distribution on a two-dimensional aerofoil in compressible inviscid flow A few examples are given of comparisons with a nominally-exact method and it is shown how the method differs from a first-order method widely used as the basis for the calculation of pressure distributions on finite swept wings and on two-dimensional aerofoils in compressible viscous flow A critical evaluation of the second-order method has shown that over a wide range of aerofoil shapes incidence and Mach number, pressure distributions calculated by the second-order method differ appreciably from nominally-exact calculations only for local regions of aerofoils where high local surface curvature occurs and over the first 20 per cent, or so, of chord for aerofoils having the bluffer leading-edge profiles Two suggested techniques for enumerating the method are outlined and reference is made to a computer program which was used to obtain results from the method Author

N75-29030*# Aerophysics Research Corp Bellevue, Wash
THEORETICAL EFFECT OF MODIFICATIONS TO THE UPPER SURFACE OF TWO NACA AIRFOILS USING SMOOTH POLYNOMIAL ADDITIONAL THICKNESS DISTRIBUTIONS WHICH EMPHASIZE LEADING EDGE PROFILE AND WHICH VARY LINEARLY AT THE TRAILING EDGE
Donald S Hague and Antony W Werz Mar 1975 32 p refs (Contract NAS2-8599)
(NASA-CR-137717, TN-197) Avail NTIS HC $3 75 CSCL 01A

An investigation was conducted on a CDC 7600 digital computer to determine the effects of additional thickness distributions to the upper surface of airfoils The additional thickness distribution had the form of a continuous mathematical function which disappears at both the leading edge and the trailing edge Results were obtained at a Mach number of 0 2 with an angle of attack of 6 deg All calculations employed the full potential flow equations for two dimensional flow The relaxation method of Jameson was used for solution of the potential flow equations It is shown that increasing the thickness and variations in shape increases the lift and the adverse pitching moment coefficients Author

N75-29031*# Pennsylvania State Univ, University Park
UNSTEADY VORTEX LATTICE TECHNIQUES APPLIED TO

WAKE FORMATION AND PERFORMANCE OF THE STATICALLY THRUSTING PROPELLER
Gerald Forrest Hall [1975] 197 p refs
(Grant NGL-39-009-172)
(NASA-CR-132686) Avail NTIS HC $7 00 CSCL 01A

The application is considered of vortex lattice techniques to the problem of describing the aerodynamics and performance of statically thrusting propellers A numerical lifting surface theory to predict the aerodynamic forces and power is performed The chordwise and spanwise loading is modelled by bound vortices fixed to a twisted flat plate surface In order to eliminate any apriori assumptions regarding the wake shape, it is assumed the propeller starts from rest The wake is generated in time and allowed to deform under its own self-induced velocity field as the motion of the propeller progresses The bound circulation distribution is then determined with time by applying the flow tangency boundary condition at certain selected control points on the blades The aerodynamics of the infinite wing and finite wing are also considered The details of wake formation and roll-up are investigated particularly the localized induction effect It is concluded that proper wake roll-up and roll-up rates can be established by considering the details of motion at the instant of start Author

N75-29032# National Aerospace Lab Tokyo (Japan)
SHEAR AND MOMENT RESPONSE OF THE AIRPLANE WING TO NONSTATIONARY TURBULENCE
Yoshinori Fujimori Jan 1975 13 p refs
(NAL-TR-404T) Avail NTIS HC $3 25

Response formulation of the shear force and bending moment of the airplane wing was established in terms of evolutionary cross spectrum Frequency distribution of the responses of arbitrary wing sections can be obtained at any time instant of interest after the airplane enters the nonstationary atmospheric turbulence Conventional stationary solutions are included in this analysis as the special case Contribution by the pitching motion is the highest to both shear amd moment responses The effect of the shear force to the stress level is negligibly smaller than that due to the bending moment When the envelope profile looks like a step function, mean square moment takes the maximum in the transient stage whose spectrum is dominated by rigid modes But the spectrum at stationary state, where its mean square moment is lower that the transient maximum, shows both rigid and flexible motions Therefore, the search of the stationary solutions only is not adequate in view of ultimate strength and fatigue life of the airplane structure Author

N75-29034# Aeronautical Research Labs , Melbourne (Australia)
HIGHER ORDER WIND TUNNEL CORRECTIONS FOR A TWO-DIMENSIONAL CIRCULAR ARC LIFTING AEROFOIL IN A CLOSED RECTANGULAR WIND TUNNEL
B W B Shaw Aug 1974 69 p refs
(ARL/A-Note-349) Avail NTIS HC $4 25

A method is presented for solving the inviscid flow past a two-dimensional airfoil in a closed rectangular wind tunnel by determining an equivalent free-air flow field containing an independent vortex Expressions for the tunnel corrections to the incidence and free-stream speed, and C sub L, C sub D, and C sub m are given for an infinitely thin circular arc cambered airfoil as quadratics in cord/tunnel height ratio (c/h) With centrally positioned airfoils, for values of c/h up to 0 3 first order theory predicts all the corrections with generally good accuracy (within 1/2% of the corrected quantity) except for delta C sub D near the stall But for airfoils with even a small vertical offset for the corrections to C sub L, C sub D, and C sub m, first order theory proves inaccurate, and the higher order equations should be used Author

N75-29035*# *Kanner (Leo) Associates, Redwood City, Calif*
EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON THE PROBLEM OF PROPELLER/WING INTERFERENCE UP TO HIGH ANGLES OF ATTACK
B Straeter Washington NASA Aug 1975 161 p refs
Transl into ENGLISH of 'Experimentelle und theoretische Untersuchungen zum Problem der Propeller-Fluegel-Interferenz bis zu Hoch Anstellwinkeln", Rept IFD-5/73 Technische Hochschule, Darmstadt, West Ger , 20 Dec 1973 181 p
(Contract NASw-2970)
(NASA-TT-F-16490, IFD-5/73) Avail NTIS HC $6 25 CSCL 01A

Propeller wing interactions for variable propeller modulus and variable propeller wing distances were measured on a model during wind tunnel tests Procedures for calculating wing coefficients and for the determination of the total force coefficients of propeller wing configurations were developed Theoretical procedures are in good agreement with experimental results Author

N75-29036*# *National Aeronautics and Space Administration* Langley Research Center Langley Station, Va
EFFORT OF SPANWISE VARIATION OF TURBULENCE ON THE NORMAL ACCELERATION OF AIRPLANES WITH SMALL SPAN RELATIVE TO TURBULENCE SCALE
Kermit G Pratt Aug 1975 37 p refs
(NASA-TM-X-72748) Avail NTIS HC $3 75 CSCL 01A

A rigid airplane with an unswept wing is analyzed The results show that the power spectrum, relative to that for a one-dimensional turbulence field, is significantly attenuated at the higher frequencies even for airplanes with arbitrarily small ratios of span to scale of turbulence This attenuation is described by a simple weighting function of frequency that depends only on aspect ratio The weighting function, together with the attenuation due to the unsteady flow of gust penetration, allows the determination of the average rate of zero crossings for airplanes having very small spans without recourse to an integral truncation which is often required in calculations based on a one-dimensional turbulence field Author

N75-29037*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
VIBRATIONS MEASURED IN THE PASSENGER CABINS OF TWO JET TRANSPORT AIRCRAFT
John J Catherines, John S Mixson, and Harland F Scholl Washington Aug 1975 55 p refs
(NASA-TN-D-7923, L-9531) Avail NTIS HC $4 25 CSCL 05H

Accelerations in the lateral and vertical directions were measured at two locations on the floor of a three-jet-engine aircraft and at two locations on the floor of a two-jet-engine aircraft during a total of 13 flights, each of which included taxiing, takeoff, ascent, cruise, descent, and landing Accelerations over the frequency range 0 to 25 Hz were recorded continuously on magnetic tape and were synchronized with the VGH recorders in the aircraft so that vibratory accelerations could be correlated with the operating conditions of the aircraft From the results it was indicated that the methodology used in segmenting the data, which were obtained in a continuous and repetitive manner, contributes to establishing baseline data representative of the flight characteristics of aircraft Significant differences among flight conductions were found to occur The lateral accelerations were approximately 15 percent of the vertical accelerations during flight but as much as 50 to 100 percent of the vertical accelerations during ground operations The variation between the responses of the two aircraft was not statistically significant The results also showed that more than 90 percent of the vibratory energy measured during flight occurred in the 0- to 3 0-Hz frequency range Generally the vibration amplitudes were normally distributed Author

N75-29038*# *Iowa State Univ of Science and Technology, Ames* Engineering Research Inst
NUMERICAL COMPUTATION OF THREE-DIMENSIONAL BLUNT BODY FLOW FIELDS WITH AN IMPINGING SHOCK
Interim Report
Terry L Holst and John C Tannehill Jul 1975 169 p refs
(Grant NGR-16-002-038)
(NASA-CR-143312, ISU-ERI-Ames-75169) Avail NTIS HC $6 25 CSCL 01A

A time-marching finite-difference method was used to solve the compressible Navier-Stokes equations for the three-dimensional wing-leading-edge shock impingement problem The

bow shock was treated as a discontinuity across which the exact shock jump conditions were applied All interior shock layer detail such as shear layers, shock waves, jets, and the wall boundary layer were automatically captured in the solution The impinging shock was introduced by discontinuously changing the freestream conditions across the intersection line at the bow shock A special storage-saving procedure for sweeping through the finite-difference mesh was developed which reduces the required amount of computer storage by at least a factor of two without sacrificing the execution time Numerical results are presented for infinite cylinder blunt body cases as well as the three-dimensional shock impingement case The numerical results are compared with existing experimental and theoretical results Author

N75-29039*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EXTRACTION FROM FLIGHT DATA OF LONGITUDINAL AERODYNAMIC COEFFICIENTS IN MANEUVERING FLIGHT FOR F-8C AIRCRAFT
William T Suit Washington Aug 1975 41 p refs
(NASA-TN-D-8019 L-10026) Avail NTIS HC $3 75 CSCL 01A

Flight-test data were used to extract the longitudinal aerodynamic parameters of the F-8C aircraft The aircraft was trimmed in a steady turn at angles of attack of approximately 9 deg and 13 deg at Mach numbers of 0 7 and 0 8 The parameters extracted resulted in a good match to the flight data and the values obtained were reasonable The values were further verified by comparing the period and time to damp to half-amplitude as calculated by using the extracted parameter values with the period and time to damp to half-amplitude actually measured from the flight data traces These results show that for the set of data examined, a mathematical model using linear aerodynamics was adequate to describe the response motions at the test angles of attack Author

N75-29043# Royal Aircraft Establishment Teddington (England) Aerodynamics Dept
THE PREDICTION OF BOUNDARY-LAYER BEHAVIOR AND PROFILE DRAG FOR INFINITE YAWED WINGS PART 2 FLOW NEAR A TURBULENT ATTACHMENT LINE
B G J Thompson London Aeron Res Council 1974 46 p refs Supersedes RAE-TR-73091 ARC-35095
(ARC-CP-1308 RAE-TR-73091 ARC-35095) Avail NTIS HC $3 75 HMSO £1 10 PHI $4 30

Calculations using the entrainment method Thompson and MacDonald show that even at flight Reynolds numbers a conventional swept wing with turbulent attachment line flow is affected by a prolonged region of reverse transition Simple assumptions were used to estimate the effect of this on boundary-layer development It is found that the profile drag is affected by several per cent, and it is thought that the shock-induced separation and scale effects for peaky transonic airfoils would be even more susceptible to the presence of laminar reversion, and that the use of an attachment line criterion for turbulent flow (such as C*) is inadequate on its own Calculations using the same boundary-layer method were made to provide charts from which a basic experiment at low speeds can be designed to investigate these problems on a yawed circular cylinder Author (ESRO)

N75-29046# Royal Aircraft Establishment, Teddington (England) Aerodynamics Dept
THE PREDICTION OF BOUNDARY-LAYER BEHAVIOUR AND PROFILE DRAG FOR INFINITE YAWED WINGS PART 1 A METHOD OF CALCULATION
B G J Thompson and A G J Macdonald London Aeron Res Council 1974 66 p refs Supersedes RAE-TR-73092 ARC-35096
(ARC-CP-1307-Pt-1 RAE-TR-73092 ARC-35096) Avail NTIS HC $4 25, HMSO £1 55 PHI $6 25

Cumpsty and Head s entrainment method for turbulent boundary layers was extended to compressible flow using Green s compressibility assumptions The laminar layer was predicted using Thwaites' method in the chordwise plane and Nash s method spanwise The Rott compressibility transformation was used, and the transition and wake assumptions are consistent with the two-dimensional profile drag method of Nash The complete method suitable for use in making routine design calculations, is described briefly The relationships between calculation time step length, and accuracy are considered for a practical infinite wing at transonic cruise conditions The global iteration technique is shown to fail in regions of favorable pressure gradient just downstream of the leading edge as correction terms involving derivatives of integral cross-flow thicknesses are no longer small A faster step-by-step numerical method was adopted to solve the differential equations of the integral turbulent boundary-layer method without convergence problems Author (ESRO)

N75-29047# Royal Aircraft Establishment, Teddington (England) Aerodynamics Dept
THE PREDICTION OF BOUNDARY-LAYER BEHAVIOUR AND PROFILE DRAG FOR INFINITE YAWED WINGS PART 3 CALCULATIONS FOR A PARTICULAR WING
B G J Thompson G A Carr-Hill and M Ralph London Aeron Res Council 1975 56 p refs Supersedes RAE-TR-73090 ARC-35094
(ARC-CP-1309-Pt-3 RAE-TR-73090 ARC-35094) Avail NTIS HC $4 25 HMSO £1 35 PHI $5 30

An integral method was used to predict boundary-layer and wake behavior for a family of infinite yawed wings having a chordwise section NPL 3111 operating at its design point Profile drag predictions show a smaller variation with yaw than a typical project office design method and the Reynolds number for incipient rear separation depends strongly on angle of yaw Scale effect on loss of lift, due to viscous displacement of the potential flow appears to be amplified by sweep
Author (ESRO)

N75-29048# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept
THE DYNAMIC STABILITY DERIVATIVES OF A SLENDER WING AT ZERO AND MODERATE LIFE A COMPARISON OF THEORY WITH FREE-FLIGHT MODEL TESTS, MACH NUMBER EQUALS 0 8 TO 2 0
A Jean Ross Geraldine F Edwards and A P Waterfall London ARC 1975 33 p refs Supersedes RAE-TR-73097 ARC-34897
(ARC-CP-1310 RAE-TR-73097 ARC-34897) Avail NTIS HC $3 75 HMSO 85p PHI $7 20

The longitudinal and lateral stability derivatives of a slender wing and fin configuration (AGARD G standard model) were measured using rocket-launched free-flight models Comparisons are made with theoretical estimates of the derivatives and with previous experimental results from models flying at near-zero lift The derivatives showing the greatest dependence on angle of attack are derived Results also show that the linear theories used for obtaining values of these same derivatives at zero lift are inadequate at transonic speeds Author (ESRO)

N75-29049# National Gas Turbine Establishment Pyestock (England)
THRUST/DRAG ANALYSIS FOR A FRONT FAN NACELLE HAVING TWO SEPARATE CO-AXIAL EXHAUST STREAMS
P G Street London Aeron Res Council 1975 39 p refs Supersedes NGTE-321 ARC-34645
(ARC-CP-1311 ARC-34645 NGTE-321) Avail NTIS HC $3 75 HMSO 90P PHI $3 65

The forces acting on and around a high by-pass ratio front fan nacelle are considered in the light of findings on thrust and drag definitions for jet engines From these considerations, thrust and drag components which take account of mutual interference are defined A technique for defining an afterbody or gas generator cowl drag in the presence of external flow, was derived and the experimental measurements required are listed Example calculations using experimental data were used to demonstrate the technique Author (ESRO)

N75-29051# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept
FREE-FLIGHT MODEL DYNAMIC STABILITY MEASURE-

MENTS ON A NOT-SO-SLENDER WING/FIN COMBINATION AT ZERO AND SMALL LIFT, MACH NUMBER EQUALS 0 8 TO 2 0

G H Greenwood and Geraldine F Edwards London ARC 1975 61 p refs Supersedes RAE-TR-74054, ARC-35501 (ARC-CP-1315 RAE-TR-74054, ARC-35501) Avail NTIS HC $4 25, HMSO £1 40 PHI $5 80

Dynamic longitudinal and lateral stability measurements were made in free flight at zero and small lift Agreement between experiment and theory is generally good but exceptions were found in the magnitude and variation of the pitching moment derivative and the pitch-damping derivative The effect of adding a small fairing in simulation of the support-sting shroud on complementary wind tunnel models appears to be confined to those stability derivatives Author (ESRO)

N75-29052# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept

SECOND-ORDER SMALL-PERTURBATION THEORY FOR FINITE WINGS IN INCOMPRESSIBLE FLOW

J Weber London Aeron Res Council 1975 53 p refs Supersedes RAE-TR-72171 ARC-34469 (ARC-R/M-3759 RAE-TR-72171 ARC-34469) Avail NTIS HC $4 25, HMSO £2 80, PHI $10 85

The incompressible second-order theory for two-dimensional airfoils was extended to finite swept wings The flow field is represented by distributions of sources and lifting singularities on the chord surface which contains the chord at each spanwise station The strength of the source distribution was obtained as the sum of the distribution from first-order theory and a correction was derived from the second-order boundary condition This involves the computation of the velocity which planar singularity distributions induce on and off the plane, the computation was done by computer programs A generally applicable solution is derived and using Taylor series expansions this solution was simplified for the part of the wing away from center and tip The problem of designing a wing of given thickness distribution (which has a prescribed pressure distribution on the upper surface) is also treated Author (ESRO)

N75-29053# British Aircraft Corp (Operating) Ltd Bristol (England)

A LIFTING SURFACE THEORY METHOD FOR TREATING SWEPT OR SLENDER WINGS IN ATTACHED SUBSONIC FLOW

W Kellaway London Aeron Res Council 1975 90 p refs Supersedes ARC-35352 (Contract MIN-DEF/PE-K5A/82) (ARC-R/M-3760 ARC-35352) Avail NTIS HC $4 75 HMSO £4 55, PHI $17 64

A method is described which is capable of calculating the loading distribution on swept or slender planforms in attached subsonic flow Preliminary numerical results are presented which demonstrate that the method produces accurate convergent loading solutions Author (ESRO)

N75-29054# Royal Aircraft Establishment, Farnborough (England) Structures Dept

A TECHNIQUE FOR ANALYSING THE RESULTS OF A FLUTTER CALCULATION

J C A Baldock London Aeron Res Council 1975 36 p ref Supersedes RAE-TR-73168, ARC-35211 (ARC-R/M-3765, RAE-TR-73168 ARC-35211) Avail NTIS HC $3 75 HMSO £1 90 PHI $7 65

A technique is presented for condensing a multi-degree-of-freedom flutter calculation so that similar flutter conditions are achieved with two degrees-of-freedom Digital computer programs were used, and the process is largely automatic Examples of the application of the technique are given which show that systems can often be reduced to two normal modes or to two orthogonal combinations of normal modes, and that these modes can be interpreted physically A detailed analysis of one of the derived two degree-of-freedom systems is made using a method restricted to a binary system the condensation technique made possible the application of this method Author (ESRO)

N75-29055# Technische Hogeschool Delft (Netherlands) Dept of Aeronautical Engineering

THE COMPUTATION OF AERODYNAMIC LOADS ON HELICOPTER BLADES IN FORWARD FLIGHT, USING THE METHOD OF THE ACCELERATION POTENTIAL

T vanHolten Mar 1975 131 p refs (VTH-189) Avail NTIS HC $5 75

A description of the flow field is presented which is based on the acceleration potential The use of the acceleration potential allows a relatively easy derivation of lifting line theory using a matched asymptotic expansion technique The systematic rather than intuitive treatment of lifting line theory afforded by this approach enables one to derive the form which lifting line theory should assume in order to be applicable to the case of the helicopter rotor Two theories were developed the first one involves errors of relative order of magnitude A to the minus 2nd power (where A is the aspect ratio of the blades), the second one is a more elaborate higher order method involving relative errors of the order A to the minus 3rd power If applied to the simpler case of the unswept wing in steady flow these methods would reduce to Prandtl s classical method and to Weissinger's 3/4-chord method respectively The matched asymtotic expansion analysis yields the complete pressure distribution over the blade s surface Author (ESRO)

N75-29056# National Aerospace Lab , Amsterdam (Netherlands) Fluid Dynamics Div

THE EFFECT OF A PYLON-MOUNTED NACELLE ON THE FLUTTER BEHAVIOUR OF A WING-PYLON-NACELLE CONFIGURATION

R Roos and R J Zwaan 26 Sep 1974 28 p refs (NLR-TR-74125-U) Avail NTIS HC $3 75

The aerodynamic interference effects on the aeroelastic behavior of a wing with a large pylon-mounted engine nacelle were investigated Theoretical unsteady pressure distributions obtained with the doublet lattice method were compared with experimental data The effect of the schematization of the pylon and nacelle was examined The flutter behavior of the configuration was analyzed theoretically, and compared with experimental results Author (ESRO)

N75-29061# Control Data Corp , St Paul, Minn Advanced Systems Div

RESULTS OF AN AIRCRAFT VISIBILITY QUESTIONNAIRE CONCERNED WITH THE ESTIMATED BENEFITS OF AIRBORNE PROXIMITY WARNING INDICATOR SYSTEMS Final Technical Report, Oct 1972 - Jan 1975

W Graham Jan 1975 152 p refs (Contract DOT-FA70WA-2263) (AD-A009884, FAA-RD-75-46) Avail NTIS HC $6 25 CSCL 01/3

The aircraft visibility questionnaire was distributed in an attempt to estimate the flying habits of various classes of pilots with respect to flight rule and meteorological conditions, to determine the opinions of these pilots about matters concerning the potential usefulness of Proximity Warning Indicators (PWI) and to poll pilot preferences with respect to the display of PWI information Pilots holding ATR and instrument ratings were sampled along with commercial and private pilots without instrument ratings, students and military pilots who held civil ratings Estimates are given of the incidence of various meteorological conditions in 21 hubs in the U S and the percent of the time that pilots elect to fly instrument flight rules and visual flight rules under these conditions Preferences of pilots for the relative bearing accuracy of PWI displays and for the type of display are reported The mean time to abandon search failing detection after receipt of a traffic advisory is given as is the estimated time required to avoid an impending collision after detection of a threatening aircraft Author

N75-29064# Mitre Corp McLean Va

CIVIL AVIATION MIDAIR COLLISIONS ANALYSIS 1972 ADDED TO 1964 - 1971 RESULTS Final Report

R A Rucker and T R Simpson Dec 1974 85 p refs (Contract DOT-FA70WA-2448) (AD-A005897, FAA-EM-73-8-Add-1, MTR-6334-Suppl-1 D-43) Avail NTIS HC $4 75 CSCL 01/2

An analysis of the potential effectiveness of alternative collision avoidance systems coverage in preventing a recurrence of similar aircraft collision fatalities of 1964-72 is presented It concludes the 26% of the collisions (6% of fatalities)are systematically unpreventable, and shows that one particular system could have prevented 18% of the collisions (51% of fatalities), including all fatal collisions which involved air carriers Author

N75-29065# Mitre Corp , McLean Va
VORTEX-RELATED ACCIDENTS OVER THE TEN YEAR PERIOD 1964 - 1973 Final Report
V P Gupta Apr 1975 82 p refs
(Contract DOT-FA70WA-2448)
(AD-A010111 FAA-EM-75-6, MTR-6852) Avail NTIS HC $4 75 CSCL 01/2

Out of the approximately 45,000 aviation accidents that occurred over the ten-year period 1964-73, in the conterminous United States, wake vortices were cited as a cause or as factor in 147 accidents by the National Transportation Safety Board (NTSB) These vortex-related accidents were studied and categorized (by flight phases of the vortex-generating aircraft and the accident aircraft and other pertinent factors) with the objective of providing historical insight to the Wake Vortex Avoidance System (WVAS) development program, and to explore the possibility of procedural solutions to the vortex problem in various situations The vortex problem was found to be largely confined to small general aviation aircraft landing or taking off close behind air carrier aircraft under VFR conditions Landing behind another landing aircraft on the same runway was found to be the most frequent type of vortex-related accident An intersection takeoff behind another takeoff from the threshold of the same runway was the second most frequent type No intersection takeoff accident has, however, occurred since 1969 when a 3-minute separation rule was adopted for intersection takeoffs Author

N75-29068# Mitre Corp McLean, Va
INTERMITTENT POSITIVE CONTROL COMPUTER ALGORITHM FOR TEST BED EXPERIMENTS
A L McFarland and J F Golden 7 Apr 1975 122 p refs Revised
(Contract DOT-FA70WA-2448)
(AD-A009215, MTR-6528-Rev-1 FAA-EM-74-2-Rev-1) Avail NTIS HC $5 75 CSCL 01/2

Computer techniques are applied to modern aircraft guidance systems Detailed flowcharts are provided and logical system interfaces are discussed Author

N75-29070# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Zentralabteilung Luftfahrttechnik
FLIGHT SAFETY WORK OF THE GERMAN AVIATION AND SPACE RESEARCH INSTITUTE
Ferdinand Schatt 14 Jan 1975 44 p refs In GERMAN ENGLISH summary Presented at the 26th Intern Air Safety Seminar of the Flight Safety Found Lisbon, 4-7 Nov 1973
(DLR-Mitt-75-05) Avail NTIS HC $3 75, DFVLR Porz, West Ger 19 20 DM

Tasks and organization of the establishment and its aeronautical research institutes are surveyed Research topics in the field of flight safety are detailed for some institutes and examples selected are based on usefulness for practical situations or aircraft operations ESRO

N75-29071# Nielsen Engineering and Research Inc Mountain View Calif
EXTENSION OF THE METHOD FOR PREDICTING SIX-DEGREE-OF-FREEDOM STORE SEPARATION TRAJECTORIES AT SPEEDS UP TO THE CRITICAL SPEED TO INCLUDE A FUSELAGE WITH NONCIRCULAR CROSS SECTION VOLUME 1 THEORETICAL METHODS AND COMPARISONS WITH EXPERIMENT Final Technical Report, Mar 1972 - Feb 1974
Marnix F E Dillenius, Frederick K Goodwin and Jack N Nielsen Nov 1974 98 p refs
(Contract F33615-72-C-1375 AF Proj 8219)
(AD-A005822 NEAR-TR-60 AFFDL-TR-74-130-Vol-1) Avail NTIS CSCL 01/3

The primary objective of this report is to describe improvements and extensions which have been made to the method of predicting six-degree-of-freedom trajectories of stores released from fighter-bomber aircraft previously published by the authors in AFFDL-TR-72-83 In the present work the circular fuselage restriction has been removed Methods are presented for flow modeling fuselages with non-circular cross sections including canopies and engine air inlets GRA

N75-29077# Purdue Univ , Lafayette Ind School of Electrical Engineering
RELIABLE LINE SIGNALING TECHNIQUES FOR THE FAA GRN-27(V) AND CAT-3 ILS Interim Report, 1 Jul - 31 Dec 1974
S C Bass, S Belter S C Chen T Findakly C Greenblatt, H Hwang B J Leon W Peele P Petrowski and C Williams Mar 1975 80 p refs
(Contract DOT-FA74WA-3518)
(AD-A009881 FAA-RD-75-11) Avail NTIS HC $4 75 CSCL 17/7

The effect of power line transients and lightning interference on solid state equipment is investigated Specifically this effort is directed toward protection of the GRN 27 (V) and the FAA MARK 3 type Instrument Landing Systems Recommended system changes consisting of changes in the method of signaling from unbalanced nonisolated to a blanced isolated configuration with tone signaling are given Author

N75-29078# Lincoln Lab Mass Inst of Tech Lexington
DABS LINK PERFORMANCE CONSIDERATIONS
G J Schlieckert 28 Apr 1975 59 p refs
(Contracts DOT-FA72WAI-261, F19628-73-C-0002)
(AD-A009429 ATC-41, FAA-RD-74-186) Avail NTIS HC $4 25 CSCL 17/7

The discrete address beacon system (DABS) link performance was computed using the present values for the system operating parameters and the available models that describe environmental and aircraft antenna effects The various fade mechanisms are described and a statistical determination of performance is proposed The performance is computed for various sets of conditions including different ground antennas, aircraft maneuvers antenna pedestal heights, ground reflection coefficients and reduced power Also discussed are the effects of obstructions and the performance when aircraft are in the cone of silence The DABS link is found to have good overall performance with only small regions of reduced reliability that are at low angles or due to maneuvers Those missed replies due to maneuvers are found to be sporadic from scan to scan Author

N75-29084# Facility Checking Squadron (1866th) (AFCS), Richards-Gebaur AFB, Mo
TACAN AND ILS STATION EVALUATION REPORT, LORING AFB, MAINE
Joseph N Raeth 13 Dec 1974 111 p
(AD-A006416, Rept-74/66N-21) Avail NTIS CSCL 17/7

The evaluation report presents data collected and analyzed to define the capabilities and limitations of the Loring AFB TACAN (AN/GRN-20B), ILS (AN/MRN-7 and AN/MRN-8), and associated power systems This report documents the inconsistent width and angle measurement indicated on the glide slope Analysis of evaluation results and recommendations are presented Airborne and ground evaluations indicated that the facilities were fully capable of providing satisfactory service GRA

N75-29087*# Joint Publications Research Service Arlington, Va
ON AN AIRPLANE IN OUTER SPACE
V Shatalov Washington NASA Jul 1975 17 p Transl into ENGLISH from Nauka i Zhizn (USSR) no 11, Nov 1974 p 25-32 Sponsored by NASA
(NASA-TT-F-16423) Avail NTIS HC $3 25 CSCL 01C

The possibility of a space aircraft are discussed in terms of the transfer of technology between aviation and space engineering The creation of aerobuses, mastery of supersonic speeds, overcoming the heat barrier the rarefield atmosphere, and the development of hypersonic aircraft as transport vehicles between earth and space stations are among the factors considered
J M S

N75-29088*# McDonnell-Douglas Astronautics Co , St Louis, Mo
A LEADING EDGE HEATING ARRAY AND A FLAT SURFACE HEATING ARRAY - OPERATION, MAINTENANCE AND REPAIR MANUAL
1 Jul 1975 122 p
(Contract NAS9-14041)
(NASA-CR-144357, MDC-E1234, JSC-09492) Avail NTIS HC $5 25 CSCL 01C

A general description of the leading edge/flat surface heating array is presented along with its components, assembly instructions, installation instructions, operation procedures, maintenance instructions, repair procedures, schematics, spare parts lists, engineering drawings of the array, and functional acceptance test log sheets The proper replacement of components, correct torque values, step-by-step maintenance instructions, and pretest checkouts are described
M J S

N75-29089*# North American Rockwell Corp , Los Angeles, Calif
THEORETICAL PREDICTION OF AIRPLANE STABILITY DERIVATIVES AT SUBCRITICAL SPEEDS
J Tulinius W Clever, A Nieman, K Dunn, and B Gaither [1973] 598 p refs
(Contract NAS1-10828)
(NASA-CR-132681, NA-72-803) Avail NTIS HC $13 25 CSCL 01C

The theoretical development and application is described of an analysis for predicting the major static and rotary stability derivatives for a complete airplane The analysis utilizes potential flow theory to compute the surface flow fields and pressures on any configuration that can be synthesized from arbitrary lifting bodies and nonplanar thick lifting panels The pressures are integrated to obtain section and total configuration loads and moments due side slip angle of attack pitching motion, rolling motion, yawing motion and control surface deflection Subcritical compressibility is accounted for by means of the Gothert similarity rule
Author

N75-29090# MAN-Acoustics and Noise, Inc , Seattle, Wash
ESTABLISHING CERTIFICATION/DESIGN CRITERIA FOR ADVANCED SUPERSONIC AIRCRAFT UTILIZING ACCEPTANCE, INTERFERENCE, AND ANNOYANCE RESPONSE TO SIMULATED SONIC BOOMS BY PERSONS IN THEIR HOMES Final Report
J E Mabry and P B Oncley Mar 1975 99 p refs
(Contract DOT-FA74WAI-444)
(AD-A009656 MAN-1010 FAA-RD-75-44) Avail NTIS HC $5 25 CSCL 01/3

Community Noise Simulation Systems were designed and fabricated, and simulated sonic booms were introduced into the homes of twelve subject families Acceptance interference and annoyance response data were obtained Three boom levels and two frequency schedules (average of two or one per hour from 0700 to 2200 hours) are studied It was concluded that for establishing a design/certification sonic boom threshold of acceptability for advanced supersonic transports a level of 87 db (using S S Stevens' Mark VI) should be considered for indoor living with not more than fifteen daily boom exposures (no nighttime booms) It was also concluded that the realistic simulation approach developed utilizing Community Noise Simulation Systems is technically feasible and has high utility It can be used to establish standards involving traffic noise, noise from airports construction noise and effects of industrial noise on surrounding communities
Author

N75-29091*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
THE EFFECT OF WING DIHEDRAL AND SECTION SUCTION DISTRIBUTION ON VORTEX BURSTING
Karen E Washburn and Blair B Gloss Aug 1975 72 p refs
(NASA-TM-X-72745) Avail NTIS HC $4 25 CSCL 01A

Eleven semi-span wing models were tested in the 1/8-scale model of the Langley V/STOL tunnel to qualitatively study vortex bursting Flow visualization was achieved by using helium filled soap bubbles introduced upstream of the model The angle of attack range was from 0 deg to 45 deg The results show that the vortex is unstable, that is, the bursting point location is not fixed at a given angle of attack but moves within certain bounds Upstream of the trailing edge the bursting point location has a range of two inches, downstream, the range is about six inches Anhedral and dihedral appear to have an insignificant effect on the vortex and its bursting point location Altering the section suction distribution by improving the triangularity generally increases the angle of attack at which vortex bursting occurs at the trailing edge
Author

N75-29093*# Douglas Aircraft Co Inc , Long Beach Calif
CONCEPTUAL DESIGN STUDY OF ADVANCED ACOUSTIC-COMPOSITE NACELLES
Kenneth E Nordstrom, Alan H Marsh, and Donald F Sargisson (GE) Jul 1975 200 p refs
(Contract NAS1-13356)
(NASA-CR-132703, MDC-J6891) Avail NTIS HC $7 00 CSCL 01C

Conceptual studies were conducted to assess the impact of incorporating advanced technologies in the nacelles of a current wide-bodied transport and an advanced technology transport The improvement possible in the areas of fuel consumption flyover noise levels, airplane weight, manufacturing costs and airplane operating cost were evaluated for short and long-duct nacelles Use of composite structures for acoustic duct linings in the fan inlet and exhaust ducts was considered as well as for other nacelle components For the wide-bodied transport, the use of a long-duct nacelle with an internal mixer nozzle in the primary exhaust showed significant improvement in installed specific fuel consumption and airplane direct operating costs compared to the current short-duct nacelle The long-duct mixed-flow nacelle is expected to achieve significant reductions in jet noise during takeoff and in turbo-machinery noise during landing approach Recommendations were made of the technology development needed to achieve the potential fuel conservation and noise reduction benefits
Author

N75-29094# Royal Aircraft Establishment, Farnborough (England) Aerodynamics Dept
LONGITUDINAL MOTIONS OF AIRCRAFT INVOLVING HIGH ANGLES OF ATTACK
H H B M Thomas and Joan Collingbourne London Aeron Res Council 1974 100 p refs Supersedes RAE-TR-73011, ARC-34703
(ARC-R/M-3753 RAE-TR-73011 ARC-34703) Avail NTIS HC $4 75 HMSO £4 85, PHI $18 85

A general introduction is presented to the longitudinal motion of aircraft over an extended range of angle of attack and various aspects were investigated of the low-speed-deceleration maneuvre with excursion of very high angles of attack in the case of failure to recover The entry into such flight conditions of two distinct types of aircraft-one with a wing of moderately large aspect-ratio and having a high tailplane, the other, a tailless slender aircraft-is considered in some detail by examining the effect of various inputs on the motion The factors influencing the ease with which control of the aircraft may be regained were studied particularly in cases in which normal recovery was achieved by forceful recovery action and those in which the aircraft only recovers after an excursion to extreme angles of attack The possibility of recovery is found to depend on the general nature of the motion under the action of markedly nonlinear aerodynamic forces and moments For aircraft having pitching-moment characteristics like those of the subject aircraft three types of motion can follow an attempt at recovery There can be a reduction to two or even one as out-lined in the appendix The problem of the stability of these motions was investigated

Examination of the allied single degree-of-freedom motion in pitch provides much insight into the more general problem, while phase-plane and similar three-dimensional plots prove useful means of displaying and interpreting results The effect of varying the aircraft characteristics was examined Various forms and levels of damping are considered as well as the more evident effects of the center-of-gravity position and the inertia-in-pitch of the aircraft Author (ESRO)

N75-29097# System Innovation and Development Corp Rolling Hills Estates Calif

AUTOMATIC EXTERNAL LOAD AQUISITION BY HELICOPTER Final Report

David T Liu Nov 1974 189 p

(Contract DAAJ02-72-C-0067 DA Proj 1F1-62203-AA-33)

(AD-A005051, USAAMRDL-TR-74-86) Avail NTIS CSCL 01/3

The objectives of this study program were to establish the system requirements, to develop conceptual designs, and to analyze the feasibility of various system designs for cargo helicopters to acquire external loads without the need for manual attachment of the load to the helicopters in a loading operation Current technology for handling external helicopter loads were reviewed Applicable cargo handling technology in commercial and maritime operation was also surveyed The characteristics of helicopter external loads and lifting provisions were analysed Army air transportability requirements were established for helicopters to identify technical and operational system design requirements for automatic load acquisition Various conceptual system designs were formulated and system feasibility analyses were conducted GRA

N75-29098# Army Aviation Systems Command St Louis Mo

MAJOR ITEM SPECIAL STUDY (MISS), UH-1H 90 DEGREES T/R GEAR BOX Interim Report, Jan 1964 - Jun 1974

Mar 1975 21 p

(AD-A006506 USAAVSCOM-TR-74-58) Avail NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA Form 2410 reportable components These are time change items and certain condition change items selected because of high cost or need for intensive management Basically, the MISS reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency (MIRF) report The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting From this data removal distribution can be plotted and an MTR (mean time to removal) can be calculated The MISS reports then investigate possible cost savings based on total elimination of selected failure modes These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program (PIP) areas GRA

N75-29099# Applied Physics Lab Johns Hopkins Univ Silver Spring Md

FULL-SCALE AERODYNAMIC AND ENGINE TESTING OF THE APL SYMDEL Mk 6 RPV

R H Cramer and M L Hill Oct 1974 133 p refs

(Contract N00017-72-C-4401)

(AD-A006283, APL-TR-1257) Avail NTIS CSCL 01/3

This report presents documentation of the wind tunnel testing of the APL Symdel Mk VI remotely piloted vehicle (RPV) The purpose of these tests was to determine the aerodynamic features, live engine performance, and active control servo responses of the RPV Standard six component aerodynamic data are given for six alternative configurations GRA

N75-29100# Army Aviation Systems Command St Louis Mo

OPTIMIZATION OF THE TIME BETWEEN AIRCRAFT OVERHAULS BY MINIMIZING MAINTENANCE COST Final Report

Shirley J Smith Florence A Gaffney Billy R Schulze D Frank Fox, and Blaine T Stone Jan 1975 70 p refs

(AD-A006505, USAAVSCOM-TR-74-53) Avail NTIS CSCL 01/3

The purpose of the study was to investigate the feasibility of determining when an aircraft should be overhauled in order to minimize the life time maintenance cost of the aircraft It was assumed that the cost of field maintenance increases as the aircraft s flight hours increase Also it was assumed that following an overhaul the cost rate drops significantly then increases again until an overhaul The total life time maintenance cost is the sum of all field maintenance costs and all overhaul costs Then the optimum time between overhauls was found as that time for which the life time maintenance cost is a minimum GRA

N75-29101# Aeronautical Systems Div Wright-Patterson AFB, Ohio

F-89 HYDRAULIC ACTUATOR COMBINATORIAL GEOMETRIC REPRESENTATION Final Report, Sep - Dec 1973

John Dunn and Gerald Bennett Jan 1975 36 p

(AD-A006435 ASD/XR-74-9 JTCG/AS-74-V-009) Avail NTIS CSCL 01/3

This report summarizes development of a computerized geometric representation of an F-89 aileron actuator for the MAGIC computer program The MAGIC program uses the techniques of combinatorial geometry to describe components and was developed for vulnerability analysis uses Procedures used to idealize the actuator and develop and debug the MAGIC descriptions are described and problems encountered are discussed Results of the MAGIC description and typical cross section plots are presented GRA

N75-29102# Aeronautical Research Associates of Princeton Inc N J

A DIRECT TIME HISTORY STUDY OF THE RESPONSE OF AN AIRPLANE TO NONSTATIONARY TURBULENCE Final Report, 15 Nov 1973 - 15 Jan 1975

John C Houbolt and Guy Williamson Jan 1975 71 p refs

(Contract F33615-74-C-3006 AF Proj 1367)

(AD-A006159, ARAP-230, AFFDL-TR-74-148) Avail NTIS CSCL 01/1

Previous nonstationary turbulence studies are discussed A novel way for evaluating the impulse response function for gust encounter is derived which automatically takes into account nonsteady lift and gust penetration effects Various nonstationary gust fields, having spectral content and level exceedance behavior representative of atmospheric turbulence, are then synthesized, airplane response is evaluated in explicit time history form so that all transient effects are included The generalized load exceedance curves derived from the time histories are compared with the results that are indicated by an existing technique which derives nonstationary results on the basis of local stationary encounters GRA

N75-29103+ Engineering Sciences Data Unit, London (England)

ESTIMATION OF SUBSONIC FAR-FIELD JET-MIXING NOISE

Jun 1973 14 p

(ESDU-74002) Copyright Avail NTIS HC $74 50

A method is described for estimating far-field jet mixing noise emanating from gas turbine exhaust for fly-over, and side-line noise level of jet aircraft The method is applicable to the far-field (distances greater than 50 jet diameters from the exit), for subsonic jets with temperature ratios between 1 and 3 2 and pressure ratios between 1 1 and 1 9 Author

N75-29106*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

SUMMARY OF MODEL VTOL LIFT FAN TESTS CONDUCTED AT NASA LEWIS RESEARCH CENTER

James H Diedrich 1975 23 p refs Presented at Workshop on Prediction Methods for Jet V/STOL Propulsion Aerodynamics Arlington Va 28-31 Jul 1975 sponsored by Naval Air Systems Command

(NASA-TM-X-71778 E-8436) Avail NTIS HC $3 25 CSCL 21E

The purpose of the tests was to obtain overall performance and influencing factors as well as detailed measurements of the internal flow characteristics The first experiment consisted of crossflow tests of a 15-inch diameter fan installed in a two-dimensional wing Tests were run with and without exit louvers over a range of tunnel speeds fan speeds and wing angle of attack The wing was used for a study of installation effects on lift fan performance The model tested consisted of three 5 5-inch diameter tip-turbine driven model VTOL lift fans mounted chord-wise in the two-dimensional wing to simulate a pod-type array Several inlet and exit cover door configurations and an adjacent fuselage panel were tested For the third program, a pod was attached to the wing and an investigation was conducted of the effect of design tip speed on the aerodynamic performance and noise of a 15-inch diameter lift fan-in-pod under static and crossflow conditions Three single VTOL lift fan stages were designed for the same overall total pressure ratio but at three different rotor tip speeds Author

N75-29108*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

APPLICATION OF REAL-TIME ENGINE SIMULATIONS TO THE DEVELOPMENT OF PROPULSION SYSTEM CONTROLS

J R Szuch 1975 13 p refs Proposed for Presentation at 11th Propulsion Conf Anaheim, Calif, 29 Sep - 1 Oct 1975, cosponsored by AIAA and SAE

(NASA-TM-X-71764, E-8416) Avail NTIS HC $3 25 CSCL 21E

The development of digital controls for turbojet and turbofan engines is presented by the use of real-time computer simulations of the engines The engine simulation provides a test-bed for evaluating new control laws and for checking and debugging control software and hardware prior to engine testing The development and use of real-time, hybrid computer simulations of the Pratt and Whitney TF30-P-3 and F100-PW-100 augmented turbofans are described in support of a number of controls research programs at the Lewis Research Center The role of engine simulations in solving the propulsion systems integration problem is also discussed Author

N75-29110*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio

POTENTIAL AND VISCOUS FLOW PREDICTION IN V/STOL PROPULSION SYSTEM INLETS

Norbert O Stockman 1974 15 p refs Proposed for presentation at Workshop on Prediction Methods for Jet V/STOL propulsion Aerodynamics, Arlington Va 28-31 Jul 1975 sponsored by the Naval Air Systems Command

(NASA-TM-X-71776 E-8434) Avail NTIS HC $3 25 CSCL 21E

Highlights of the method of analysis of inlet flow are given To indicate the accuracy of the method, several comparisons with experiments for different V/STOL inlet configurations and various operating conditions are given Applications to inlet design and analysis are then discussed A summary of current efforts is given, and areas of possible future work are indicated Author

N75-29111# Aeronautical Research Labs, Melbourne (Australia)

AIRCRAFT ENGINE SPEED AND FUEL FLOW SIGNAL CONDITIONER WITH DIGITAL OUTPUT

K F Fraser Nov 1974 44 p refs

(ARL/ME-Note-354) Avail NTIS HC $3 75

Engine speed and fuel flow rate sensors typically provide outputs in the form of a pulse train with repetition rate proportional to the measurand Digitization of such data is readily accomplished by counting the number of pulses received per unit time A conditioner which produces such digitization is described It has the special property that no pulses are ever missed when the contents of the counter are transferred to associated data recording equipment Thus the conditioner can be used for accurate totalizing or engine revolutions of fuel consumed over long periods Author

N75-29112*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va

ANNOYANCE RESULTING FROM INTRUSION OF AIRCRAFT SOUNDS UPON VARIOUS ACTIVITIES Final Technical Report

Walter J Gunn William T Shepherd and John L Fletcher (Memphis State Univ, Tenn) 8 Aug 1975 85 p refs

(Grant NGR-43-008-008) Avail NTIS HC $4 75 CSCL 20A

An experiment was conducted in which subjects were engaged in TV viewing, telephone listening or reverie (no activity) for a 1/2-hour session During the session they were exposed to a series of recorded aircraft sounds at the rate of one flight every 2 minutes Within each session four levels of flyover noise separated by dB increments, were presented several times in a Latin Square balanced sequence The peak level of the noisiest flyover in any session was fixed at 95, 90, 85, 75, or 70 dBA At the end of the test session, subjects recorded their responses to the aircraft sounds using a bipolar scale which covered the range from very pleasant to extremely annoying Responses to aircraft noises were found to be significantly affected by the particular activity in which the subjects were engaged Not all subjects found the aircraft sounds to be annoying Author

N75-29113# H H Aerospace Design Co, Elmsford, N Y

SURVEY OF SONIC BOOM PHENOMENA FOR THE NON-SPECIALIST Final Report, Jun 1974 - Feb 1975

Simon Slutsky Feb 1975 104 p refs

(Contract DOT-FA74WAI-468)

(AD-A009663, HHA-14, FAA-RD-75-68) Avail NTIS HC $5 25 CSCL 20/1

The technical concepts in the field of sonic boom research are reviewed A nontechnical discussion of acoustic mechanisms which are fundamental in sonic boom phenomena is included using photographs of water analogues Basic concepts discussed include sound generation sound propagation noise reduction human response structural and wildlife response, threshold Mach *number operations, and simulation methods* Author

N75-29114# Advisory Group for Aerospace Research and Development, Paris (France)

TECHNICAL EVALUATION REPORT ON FLUID DYNAMICS PANEL SYMPOSIUM ON AIRFRAME/PROPULSION

E C Carter (Aircraft Res Assoc Bedford, Engl) May 1975 14 p refs Symp held at Rome, 3-6 Sep 1974

(AGARD-AR-81) Avail NTIS HC $3 25

Topics discussed at the symposium include air intakes and airframe inlet interactions nozzles/afterbodies flow field and airframe interference, wind tunnel testing and correlation with flight data, and integration design and accounting procedures Main recommendations made are there is urgent need for high quality afterbody pressure and force data, contradictory trends of drag with Reynolds number variation in windtunnel and flight must be resolved, the need for extended wind tunnel Reynolds number capability is again demonstrated, engine simulator techniques require development and validation theoretical treatment of mixing of afterbody and jet flows and of afterbody distortion effects must be extended, theoretical treatment of intake buzz requires development Author

N75-29115*# Tennessee Univ, Knoxville Mechanical and Aerospace Engineering Dept

NOISE SUPPRESSION WITH HIGH MACH NUMBER INLETS

Edward Lumsdaine Jenn G Cherng, Ismail Tag and Lorenzo R Clark (NASA Langley Res Center) 15 Jul 1975 108 p refs

(Grant NsG-1081)

(NASA-CR-143314) Avail NTIS HC $5 25 CSCL 20A

The parameters affecting the aerodynamic and acoustic performance of high Mach number inlets using the translating centerbody and fixed geometry configurations were studied along with the effects of area ratio length/diameter ration, and lip geometry on the acoustic and aerodynamic performance when the rotor is at subsonic as well as supersonic tip speed The results support earlier findings that the translating centerbody type inlet is superior to the collapsing cowl, both acoustically

and aerodynamically especially at moderately high area ratios The length/diameter ratio does not seem to be as crucial to performance near choked flow as area ratio Inlets operating at high Mach numbers are more effective in reducing high frequency noise At choked flow however the low frequency noise is also effectively reduced It is shown that the actual amount of noise reduction depends on the flow downstream of the throat (pressure recovery) in contradiction to inviscid theory Choking does not guarantee a large amount of noise reduction if it is accompanied by high pressure loss Thus, without boundary layer control, choked inlets are area ratio limited Using the test results, an empirical formula was derived, relating the noise reduction to percent of maximum mass flow and pressure recovery Author

N75-29116*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
A COMPUTER PROGRAM FOR HELICOPTER ROTOR NOISE USING LOWSON'S FORMULA IN THE TIME DOMAIN
C Lucille Parks 22 Jul 1975 92 p refs
(NASA-TM-X-72759) Avail NTIS HC $4 75 CSCL 20A

A computer program (D3910) was developed to calculate both the far field and near field acoustic pressure signature of a tilted rotor in hover or uniform forward speed The analysis, carried out in the time domain is based on Lowson s formulation of the acoustic field of a moving force The digital computer program is described, including methods used in the calculations, a flow chart, program D3910 source listing instructions for the user, and two test cases with input and output listings and output plots Author

N75-29117*# Boeing Commercial Airplane Co , Seattle, Wash
WIND TUNNEL TEST OF MODEL TARGET THRUST REVERSERS FOR THE PRATT AND WHITNEY AIRCRAFT JT8D-100 SERIES ENGINES INSTALLED ON A 727-200 AIRPLANE
D Hambly Sep 1974 157 p refs
(Contract NAS3-17842)
(NASA-CR-134709, D6-41900) Avail NTIS HC $6 25 CSCL 21E

The results of a low speed wind tunnel test of 0 046 scale model target thrust reversers installed on a 727-200 model airplane are presented The full airplane model was mounted on a force balance except for the nacelles and thrust reversers which were independently mounted and isolated from it The installation had the capability of simulating the inlet airflows and of supplying the correct proportions of primary and secondary air to the nozzles The objectives of the test were to assess the compatibility of the thrust reversers target door design with the engine and airplane The following measurements were made hot gas ingestion at the nacelle inlets, model lift, drag, and pitching moment, hot gas impingement on the airplane structure, and qualitative assessment of the rudder effectiveness The major parameters controlling hot gas ingestion were found to be thrust reverser orientation, engine power setting, and the lip height of the bottom thrust reverser doors on the side nacelles The thrust reversers tended to increase the model lift, decrease the drag, and decrease the pitching moment Author

N75-29118*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
EVALUATION BY STEP RESPONSE TESTS OF PROTOTYPE RELIEF VALVES DESIGNED FOR YF-12 INLET STABILITY BLEED SYSTEM
Miles O Dustin and George H Neiner Washington Aug 1975 45 p refs
(NASA-TM-X-3262 E-8135) Avail NTIS HC $3 75 CSCL 20D

Two stability bleed system relief valves were tested in a special dynamic test facility These poppet valves are prototypes for a stability bleed system designed for use in a YF-12 flight inlet One valve is unshielded, while the other has a special shield to eliminate the flow effect pressures on the piston The tests determined the size of a damping orifice to be used during wind tunnel tests of the bleed system and verified an analog simulation of the valves The effects of initial pressure level, pressure step size and spring rate were investigated Author

N75-29119*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
BASELINE MEASUREMENT OF THE NOISE GENERATED BY A SHORT-TO-MEDIUM RANGE JET TRANSPORT FLYING STANDARD ILS APPROACHES AND LEVEL FLYOVERS
Earl C Hastings, Jr , Robert E Shanks, and Arnold W Mueller 4 Aug 1975 62 p refs
(NASA-TM-X-72760) Avail NTIS HC $4 25 CSCL 20A

The results of baseline noise flight tests are presented Data are given for a point 1 85 kilometers (1 0 nautical mile) from the runway threshold, and experimental results of level flyover noise at altitudes of 122 meters (400 feet) and 610 meters (2,000 feet) are also shown for several different power levels The experimental data are compared with data from other sources and reasonable agreement is noted A description of the test technique, instrumentation, and data analysis methods is included Author

N75-29120*# Scientific Translation Service, Santa Barbara, Calif
CALCULATION OF AIRCRAFT ENGINE TURBINES (GASDYNAMIC CALCULATION BLADE PROFILING)
S Z Kopelev and N D Tikhonov Washington NASA Aug 1975 330 p refs Transl into ENGLISH of the book Raschet Turbin Aviatsionnykh Dvigateley (Gazodinamicheskiy Raschet Profilirovaniye Lopatok)' Moscow Mashinostroyeniye Press, 1974 p 1-268
(Contract NASw-2483)
(NASA-TT-F-16367) Avail NTIS HC $9 50 CSCL 21E

A generalization is presented for various methods of gas-turbine design including an evaluation of methods of gasdynamic calculation of turbine stages, methods of blade profiling, and methods of calculating cooled blades The size and weight characteristics of a turbine and their dependence on the main engine parameters are considered, and the relation between gasdynamic and strength parameters of a turbine is discussed, with allowance for its structural features and fabrication technology, paying special attention to choice of the layout and dimensions of the air-gas flow area and to the profiling of both nozzle and rotor blades To facilitate understanding of the theory, and number of examples of specific calculations based on given numerical values of the initial parameters are presented which pertain to single-stage and multistage gas turbines of turbojet engines Author

N75-29121*# United Air Lines, Inc , Chicago, Ill
ENGINEERING SIMULATION EVALUATION OF THE TWO-SEGMENT NOISE ABATEMENT APPROACH IN THE DOUGLAS DC-8-61
W E Nylen 15 Apr 1974 26 p
(Contract NAS2-7475)
(NASA-CR-137665) Avail NTIS HC $3 75 CSCL 20A

The development and operational evaluation are discussed of a noise abatement two-segment approach which is safe and operationally acceptable for routine use in air carrier service An engineering simulation evaluation was conducted, it was found that the entry speed and initial configuration are more important in the DC-8-61 than in the 727 because of the DC-8's aerodynamic cleanliness and drag programming constraints It was also found that the altitude required for the DC-8 upper and lower transitions is less than the 727 transitions principally due to the pitching moment from the underslung DC-8 engines as compared to the 727 engines which produce no pitching moment with a change in thrust The 727 approach was a reduced flaps (30 degrees) procedure with a 10-knot airspeed bleed in the lower transition, the DC-8 approach is a full flaps (50 degrees) procedure with constant airspeed established as soon as possible after upper segment transition M J S

N75-29122# National Aerospace Lab , Tokyo (Japan)
DIGITAL FUEL CONTROLLER FOR LIFT JET ENGINE
Kenji Nishio, Masanori Endo, Nanahisa Sugiyama, Takeshi Koshinuma, and Yukio Matsuda Sep 1974 28 p refs In

JAPANESE, ENGLISH summary
(NAL-TR-389) Avail NTIS HC $3 75

A digital electronic engine controller with the on line control of lift jet engine JR-100H with a mini-computer is studied The design program and fabrication of the demonstrator unit are described along with the test results of on line control of JR-100H Author

N75-29125# Colt Industries, Inc , West Hartford, Conn Control Systems Div
MINIATURIZED HIGH SPEED CONTROLS FOR TURBINE ENGINES FABRICATION AND TEST Final Report, May 1973 - Aug 1974
D G Burnell, M A Cole, T B Morrison, A H White, and R D Zagranski Aug 1974 205 p refs
(Contract F33615-73-C-2040, AF Proj 3066)
(AD-A006108, AFAPL-TR-74-93) Avail NTIS CSCL 21/5

This report summarizes the design and development of control components and high speed fuel pump technology for future drone, missile and RPV gas turbine engines The hardware was designed for installation on an existing engine to provide a vehicle for control mode demonstration and evaluation testing The developed hardware includes a fluidic/linear variable differential transformer delta P/P airflow sensor, a radiation pyrometer for sensing turbine blade temperature, three pressure transducers for sensing burner pressure (variable capacitance strain gage, and potentiometric types), a 70,000 rpm centrifugal pump and proportional solenoid-operated fuel metering system a magnetic clutch-driven 12,000 rpm gear pump for fuel metering and fuel pressurization, and an electronic unit for interfacing these components with an engine test cell digital computer GRA

N75-29126*# Scientific Translation Service, Santa Barbara Calif
FLIGHT CONTROL AND THE EFFECTIVENESS OF AN AVIATION SYSTEM
V V Andreyevskiy and L B Goroshchenko Washington NASA Jul 1975 264 p refs Transl into ENGLISH of the book *Upravleniye Poletom i Effektivnost Aviatsionnogo Kompleksa* Moscow Mashinostroyeniye Press 1974 p 1-176
(Contract NASw-2483)
(NASA-TT-F-16262) Avail NTIS HC $8 50 CSCL 01C

Methods are presented for evaluating the technical flight characteristics of an aviation complex in terms of the efficiency with which operations are performed A valid reduction of the operational model and its stages was performed using methods based on guaranteed evaluations under indeterminate conditions An examination was made of problems of selecting criteria for flight operation efficiency, compiling maneuvers which are optimum in terms of effectiveness and formulating the trajectories as a whole Methods are given for optimizing the trajectory in the case of additional relationships and limitations arising from the aircraft operation Flight regimes programs and methods of controlling the aircraft when encountering or leaving a given point in space were examined Author

N75-29127*# Southwest Research Inst San Antonio Tex
A SIMULATION STUDY OF ACTIVE FEEDBACK SUPRESSION OF DYNAMIC RESPONSE IN HELICOPTER ROTOR BLADES Final Report
Daniel D Kana Roger L Bessey, and Franklin T Dodge 1 Jul 1975 76 p refs
(Contract NAS1-12974 SwRI Proj 02-3895)
(NASA-CR-132711) Avail NTIS HC $4 75 CSCL 01C

A parameter study is presented for active feedback control applied to a helicopter rotor blade during forward flight The study was performed on an electromechanical apparatus which included a mechanical model rotor blade and electronic analog simulation of interaction between blade deflections and aerodynamic loading Blade response parameters were obtained for simulated vortex impinging at the blade tip at one pulse per revolution, and for a pulse which traveled from the blade tip toward its root Results show that the response in a 1 - 10-per-rev frequency band is diminished by the feedback action but at the same time responses at frequencies above 10-per-rev become increasingly more prominent with increased feedback amplitude and can even lead to instability at certain levels It appears that the latter behavior results from limitations of the laboratory simulation apparatus rather than genuine potential behavior for a prototype helicopter Author

N75-29128*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
A THROAT-BYPASS STABILITY SYSTEM FOR A YF-12 AIRCRAFT RESEARCH INLET USING SELF-ACTING MECHANICAL VALVES
Gary L Cole, Miles O Dustin, and George H Neiner 1975 14 p refs Proposed for presentation at 11th Propulsion on Conf Anaheim Calif , 29 Sep - 1 Oct 1975, cosponsored by AIAA and SAE
(NASA-TM-X-71779 E-8437) Avail NTIS HC $3 25 CSCL 01C

Results of a wind tunnel investigation are presented The inlet was modified so that airflow can be removed through a porous cowl-bleed region in the vicinity of the throat Bleed plenum exit flow area is controlled by relief type mechanical valves Unlike valves in previous systems these are made for use in a high Mach flight environment and include refinements so that the system could be tested on a NASA YF-12 aircraft The valves were designed to provide their own reference pressure The results show that the system can absorb internal-airflow-transients that are too fast for a conventional bypass door control system and that the two systems complement each other quite well Increased tolerance to angle of attack and Mach number changes is indicated The valves should provide sufficient time for the inlet control system to make geometry changes required to keep the inlet started Author

N75-29129# Bendix Corp , Teterboro N J Flight Systems Div
DIGITAL FLIGHT CONTROL SYSTEM REDUNDANCY STUDY Final Report, Mar 1973 - May 1974
John McGough Kurt Moses Walter Platt Gibson Reynolds and John Strole Jul 1974 341 p
(Contract F33615-73-C-3035 AF Proj 1987)
(AD-A006411 AFFDL-TR-74-83) Avail NTIS CSCL 01/3

Redundancy requirements and trade-off criteria are established for flight critical digital flight control systems with particular emphasis on the fly-by-wire application The use of general purpose digital computers is considered with self-test and cross-channel comparison monitoring techniques to obtain the necessary flight safety reliability A reliability model is presented which includes the effects of detected and undetected failures and provides a basis for establishing in-flight and preflight test coverage requirements consistent with a given reliability goal GRA

N75-29130*# Grumman Aerospace Corp Bethpage N Y
USER'S GUIDE FOR A REVISED COMPUTER PROGRAM TO ANALYZE THE LRC 16 FOOT TRANSONIC DYNAMICS TUNNEL ACTIVE CABLE MOUNT SYSTEM
J Chin and P Barbero Jul 1975 129 p refs
(Contract NAS1-10635)
(NASA-CR-132692) Avail NTIS HC $5 75 CSCL 14B

The revision of an existing digital program to analyze the stability of models mounted on a two-cable mount system used in a transonic dynamics wind tunnel is presented The program revisions and analysis of an active feedback control system to be used for controlling the free-flying models are treated Author

N75-29188*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
RECENT NASA PROGRESS IN COMPOSITES
R R Heldenfels Aug 1975 51 p refs Presented at USAF/NASA Symp on Composites an Assessment of the Future Washington, D C 11-12 Jun 1975
(NASA-TM-X-72713) Avail NTIS HC $4 25 CSCL 11D

The application of composites in aerospace vehicle structures is reviewed Research and technology program results and specific

applications to space vehicles aircraft engines, and aircraft and helicopter structures are discussed in detail Particular emphasis is given to flight service evaluation programs that are or will be accumulating substantial experience with secondary and primary structural components on military and commercial aircraft to increase confidence in their use Author

N75-29286# National Aviation Facilities Experimental Center, Atlantic City, N.J
DATA LINK SHORT-MESSAGE COCKPIT DISPLAY TEST Final Report, Nov. 1972 - Nov 1973
Donald Larson Dec 1974 124 p refs
(AD-A005988, FAA-NA-74-1) Avail NTIS HC $5 25 CSCL 17/2

Pilot/cockpit displays were evaluated for air traffic control messages The displays were (1) gas discharge, (2) light-emitting diodes, (3) fiber optics, and (4) cathode-ray tube displays Data obtained were in the form of questionnaires and measured controller response time to the messages The results are used to determine the optimum display for crew environment tests It was found that, through training and practice, pilot crews can readily set up cockpit procedures and operate in an ATC data link display communications environment Author

N75-29287# Lincoln Lab, Mass Inst of Tech, Lexington
AN ANALYSIS OF AIRCRAFT L-BAND BEACON ANTENNA PATTERNS
G J Schlieckert 15 Jan 1975 115 p
(Contract DOT-FA72WAI-261 F19828-C-0002)
(AD-A005569, ATC-37, FAA-RD-74-144) Avail NTIS HC $5 25 CSCL 17/2

Radiation patterns are examined for L-Band beacon antennas mounted on aircraft ranging from small, single-engine, general aviation aircraft to the Boeing 747 The data analyzed consists of antenna gain values taken in two degree (2 deg) steps over a spherical surface centered at the antenna location Data from three representative scale model aircraft are studied in detail and show the effects of various airframe structural members on the radiation lobing patterns and the relative performance of antennas located at a number of positions on each scale model aircraft Significant observations were that landing gear and flaps complicate the lobing structure but do not introduce many more low gain values, antennas mounted forward of the leading edge of the wing and on the fuselage bottom centerline (not too close to nosewheel) provide the best overall performance, and as an aircraft maneuvers antenna performance degrades in direct relationship with the severity of the roll or pitch Author

N75-29339# Naval Postgraduate School Monterey Calif
INDUCED CURRENTS ON TWO DIMENSIONAL ELECTROMAGNETIC PLANAR STRUCTURES M S Thesis
Jose Alberto Rospigliosi Balta and Richard W Adler Dec 1974 107 p refs
(AD-A005733 NPS-52AB74124) Avail NTIS CSCL 20/14

Electromagnetic pulse has become a possible threat to nearly all sophisticated military systems The crossed dipole receiving antenna has been used as a representative model to approximate electromagnetic pulse effects on aircraft A very basic way to approximate an aircraft structure is by a two-dimensional cross The paper is an application of the Piecewise-Sinusoidal Reaction Matching Technique (PSRMT) to find the current density distribution in a two-dimensional cross illuminated by a monochromatic plane wave Other two-dimensional structures are solved previous to the cross structure in order to gain insight and to validate this approach with respect to previous solution techniques GRA

N75-29351*# Massachusetts Inst of Tech, Cambridge Aeroelastic and Structures Research Lab
WIND TUNNEL GENERATION OF SINUSOIDAL LATERAL AND LONGITUDINAL GUSTS BY CIRCULATION OF TWIN PARALLEL AIRFOILS
Norman D Ham Paul H Bauer, and Thomas L Lawrence Aug 1974 32 p refs
(Contract NAS2-7262)
(NASA-CR-137547 ASRL-TR-174-3) Avail NTIS HC $3 75 CSCL 20D

A gust generator capable of producing sinusoidal lateral and longitudinal gusts was developed for the purpose of studying the gust response of a model rotor-propeller in a wind tunnel The gust generator utilized harmonic circulation control of twin parallel airfoils to achieve the harmonic lift variation required for gust generation The gust generator design construction and testing is described Typical test results are presented in the form of lateral and longitudinal gust perturbation velocities as a function of generator reduced frequency Author

N75-29353*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
EXPERIMENTALLY DETERMINED AEROACOUSTIC PERFORMANCE AND CONTROL OF SEVERAL SONIC INLETS
Brent A Miller 1975 22 p refs Proposed for presentation at 11th Propulsion Conf, Anaheim Calif 29 Sep - 1 Oct 1975, cosponsored by AIAA and SAE
(NASA-TM-X-71767, E-8422) Avail NTIS HC $3 25 CSCL 20D

Low speed wind tunnel tests were conducted to determine the aeroacoustic performance of several model sonic inlets The results were analyzed to indicate how inlet aeroacoustic characteristics were affected by inlet design and operating conditions A system for regulating sonic inlet noise reduction was developed and tested Results indicate that pressure losses at forward velocity may be substantially less than those at static conditions This is particularly true for translating centerbody inlets with the centerbody extended in the approach and landing position Operation to simulated takeoff incidence angles of 50 degrees was demonstrated with good inlet performance Inlet sound pressure level reduction was regulation was regulated to within approximately + or - 1 dB by controlling inlet surface static pressure measured at the diffuser exit Author

N75-29359*# Advanced Technology Labs, Inc Westbury, N Y
AN IMPROVED NUMERICAL PROCEDURE FOR THE PARAMETRIC OPTIMIZATION OF THREE DIMENSIONAL SCRAMJET NOZZLES
S Dash and P D DelGuidice May 1975 87 p refs
(Contract NAS1-13303)
(NASA-CR-132695 ATL-TR-215) Avail NTIS HC $4 75 CSCL 20D

A parametric numerical procedure permitting the rapid determination of the performance of a class of scramjet nozzle configurations is presented The geometric complexity of these configurations ruled out attempts to employ conventional nozzle design procedures The numerical program developed permitted the parametric variation of cowl length, turning angles on the cowl and vehicle undersurface and lateral expansion, and was subject to fixed constraints such as the vehicle length and nozzle exit height The program required uniform initial conditions at the burner exit station and yielded the location of all predominant wave zones, accounting for lateral expansion effects In addition, the program yielded the detailed pressure distribution on the cowl, vehicle undersurface and fences, if any, and calculated the nozzle thrust, lift and pitching moments Author

N75-29361*# Advanced Technology Labs, Inc Westbury N Y
AN IMPROVED SOURCE FLOW CHARACTERISTIC TECHNIQUE FOR THE ANALYSIS OF SCRAMJET EXHAUST FLOW FIELDS
P DelGuidice and S Dash May 1975 32 p refs
(Contract NAS1-13303)
(NASA-CR-132697, ATL-TR-213) Avail NTIS HC $3 75 CSCL 20D

The process is discussed of designing a nozzle for a hypersonic airbreathing vehicle which involves a complex study of the inter-relationship among many parameters internal-external expansion vehicle lift, drag, pitching moments, and structural

and weight limitations The source flow characteristic approach to the design process was extended and improved, and streamline interpolation procedure was incorporated All characteristic and boundary calculations were made compatible with frozen, equilibrium and ideal gas thermodynamic options while slip surface calculations (cowl interaction) were extended to underexpanded flow conditions Since viscous forces can significantly influence vehicle forces pitching moments and structural/weight considerations a local integration via flat plate boundary layer skin friction and heat transfer coefficients was included These effects are calculated using the Spalding and Chi method and all force and moment calculations are performed via integration of the local forces acting on the specified vehicle wetted areas Author

N75-29370# Technische Hogeschool Delft (Netherlands) Dept of Aeronautical Engineering

MEASUREMENTS AT THE LEEWARD SIDE OF A CONE AT LARGE INCIDENCES IN SUPERSONIC FLOW

R Houwink Dec 1974 65 p refs

(VTH-186) Avail NTIS HC $4 25

The leeward flow field of a 7 5 deg half angle cone at incidences between 14 and 35 deg was investigated in a Mach 3 flow The investigation was carried out in a supersonic blowdown wind tunnel A qualitative investigation of the leeward flow structure at incidences between 16 and 25 deg using schlierenphotographs and pitot tube transverses indicates a symmetric and approximately conical flow field with vortices and imbedded shockwaves Above an incidence of about 28 deg the flow is nonconical and asymmetric At these large incidences a steady asymmetric system of vortices seems to be present separating periodically with distance from the cone tip from the leeward cone surface At angle of attack between 16 and 25 deg the distribution of flow properties in the leeward plane of symmetry was determined using pitot probes and a static pressure/directional wedge probe Results indicate an expansion toward the cone surface, at incidences above 20 deg causing a conically supersonic velocity just above an oblique shockwave close to the leeward cone surface The distribution of conical Mach number has a maximum value about halfway between the cone surface and the free stream direction At incidences of 21 65 and 25 deg a vortical singularity-like stagnation point and a near-wake stagnation point are present Author (ESRO)

N75-29378# Michigan Univ Ann Arbor Dept of Mechanical Engineering

THE IMPACT BETWEEN A LIQUID DROP AND AN ELASTIC HALF-SPACE Ph D Thesis

Jia-Bo Gilbert Hwang Mar 1975 208 p refs

(Grant NSF 40130)

(PB-241155/1, UMICH-012449-5-T) Avail NTIS HC $7 25 CSCL 20D

The high pressure and stress induced during the collision of a liquid drop (or jet) and solid body are responsible for the erosion of steam turbine blades and aircraft components They can also be used to cut nonmetallic materials and to fracture rocks The hydrodynamic behavior of the liquid drop and the elastodynamic response of the solid body were computer-simulated They dynamic equations for a compressible inviscid fluid, neglecting the surface tension and body force, were solved by the modified compressible cell and marker numerical scheme The dynamic equations for a homogeneous isotropic elastic half-space were solved by a finite difference method GRA

N75-29381* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

G-LOAD MEASURING AND INDICATOR APPARATUS Patent

James C Howard, inventor (to NASA) Issued 22 Jul 1975 11 p Filed 12 Jun 1974

(NASA-Case-ARC-10806-1, US-Patent-3,895,521, US-Patent-Appl-SN-478802, US-Patent-Class-73-178R) Avail US Patent Office CSCL 14B

A g-load measuring apparatus for facilitating pilot control of g-load during maneuvering and to provide an indication of g-load constraint violations is proposed The apparatus includes processing means for receiving the components of the linear acceleration and angular velocity of the aircraft and for generating the first output signal indicative of the critical velocity of the aircraft and a second output signal indicative of the instantaneous maneuvering velocity of the aircraft Indicating means are connected to the processing means for receiving the two output generated signals such that the relative magnitude of the two signals is compared to provide an indication of the relative freedom of maneuverability of the aircraft and/or any g-load constraint violation that might exist

Official Gazette of the U S Patent Office

N75-29393# Army Foreign Science and Technology Center, Charlottesville, Va

APPLICATION OF THE HELICOPTER KA-26 TO LARGE-SCALE AERIAL PHOTOGRAPHY

A G Vanin and A Yu Tankus 23 Jan 1974 11 p Transl into ENGLISH from Geodeziya i Kartografiya (USSR), no 6, 1972 p 35-40

(AD-A005950 FSTC-HT-23-0826-73) Avail NTIS CSCL 14/5

The KA-26 helicopter and its use in large-scale aerial photography is described Weight, camera characteristics, photographic speeds and area limitations are discussed in detail GRA

N75-29395# Block Engineering, Inc Cambridge, Mass

FIREBIRD INTERFEROMETER Final Report, Jul 1972 - Dec 1974

Paul G J Morse Jan 1975 55 p

(Contracts F33615-72-C-2142 F33615-71-C-1074 ARPA Order 2116, AF Proj 7660)

(AD-A005815, AFAL-TR-340) Avail NTIS CSCL 20/6

The purpose of this program was the development of a reduced background infrared spectrometer to be installed on board a U-2 aircraft It was expected that data obtained from the system would help resolve questions concerning long wavelength infrared plume emission mechanisms and specific radiating species in the 5 - 14 micrometer region In addition to the spectrometer, the program required the development of a ground based data processing system for on-site quick look analysis of the data returned from the airborne spectrometer The spectrometer designed and constructed under this program consisted of a rapid scanning, high spectral resolution Michelson interferometer operating at liquid nitrogen temperatures The remaining support subsystems, including, the data processing system the two axis stabilized gimbal tracking system, the airborne liquid nitrogen supply reservoir, and the interferometer control electronics were successfully completed GRA

N75-29417# Air Force Inst of Tech Wright-Patterson AFB, Ohio Schools of Systems and Logistics

A GASP 4 SIMULATION OF TACTICAL AIR INTERDICTION USING A CHOICE OF WEAPONS LOADS AND CONTINUOUSLY CHANGING WEATHER CONDITIONS M S Thesis

Ronald G Bailey and Joseph R Szwarc Jan 1975 165 p refs

(AD-A006349, SLSR-20-75A) Avail NTIS CSCL 15/7

The thesis simulates tactical air strike missions with a choice between unguided and laser-guided weapons Weather at target point is known at a time prior to strike aircraft arrival The simulation has a choice of three load decision rules always load conventional, always load guided, or load aircraft with unguided versus guided bombs based on probability tables, using Markov chain principles, to estimate weather over target at n hours Weather probability tables will dictate type of munition loaded The actual weather at target is simulated using GASP IV, a computer language which allows continuous event simulation GASP IV is used to simulate weather fronts moving toward target(s) The speed and distance between fronts is based on historical weather data GASP IV changes the weather conditions at the target as a front moves over it Strike results are based on actual weather, type of bomb-loads, and the air defense at target GRA

N75-29433*# Detroit Diesel Allison Indianapolis Ind
PRELIMINARY DESIGN STUDY OF A QUIET, HIGH FLOW FAN (QHF) STAGE
C L Walker L S Kisner R A Delaney, A A Beguhn and D E Frye 15 Oct 1974 74 p refs
(Contract NAS3-18521)
(NASA-CR-134780, EDR-8317) Avail NTIS HC $4 25 CSCL 13I

Concepts selected to reduce fan generated noise in a turbofan are presented Near-sonic flow at the fan inlet to reduce upstream propagated noise and the use of long-chord vanes to reduce downstream noise is discussed The near-sonic condition at the rotor inlet plane was achieved by designing for high specific mass flow and by maintaining the high flow at reduced power by variable stators and variable fan exhaust nozzle The long-chord vanes reduce response to unsteady flow The acoustic design showed that long-chord stators would significantly reduce turbofan source noise and that other stator design parameters have no appreciable effect on noise for the spacing and chord length of the turbofan design Four rig flow paths studied in the aerodynamic preliminary design are discussed Noise prediction results indicate that a turbofan powered aircraft would be under federal air regulations levels without any acoustic treatment Author

N75-29453# Southwest Research Inst, San Antonio, Tex
FATIGUE DAMAGE EQUIVALENCE OF FIELD AND SIMULATED VIBRATIONAL ENVIRONMENTS Final Report, 1 Nov 1973 - 30 Dec 1974
Daniel D Kana and Dennis C Scheidt Nov 1974 54 p refs
(Contract DAAD05-74-C-0729 SwRI Proj 02-3825)
(AD-A006226) Avail NTIS CSCL 15/5

A method is developed for comparing the fatigue damage equivalence of field and laboratory simulated vibration environments It involves the use of a model hardware specimen which is instrumented to record typical strain-time histories that occur in a given environment The device is used to acquire data from both the field and corresponding laboratory simulation The resulting strain-time histories are analyzed for fatigue damage potential This analysis is based on the use of fatigue life gages A mission ratio is defined for each pair of strain histories so that the degree of simulation achieved can be expressed in terms of the number of equivalent missions experienced The technique is applied to OH-58A Helicopter, M-35 Truck, and M-113 Armored Personnel Carrier vehicle environments and their simulations It is found that a typical uniaxial test simulation provides a rather poor duplication of the actual multi-axial field environments GRA

N75-29454# Military Aircraft Storage Disposition Center Davis-Monthan AFB Ariz
DESERT STORAGE TEST PROGRAM Final Report, Jan 1972 - Feb 1974
William C Connors, John A Blind, and Leslie R Klein 20 Mar 1974 250 p refs
(AD-A006103) Avail NTIS CSCL 01/3

This report examines long term aircraft preservation and storage procedures at the Military Aircraft Storage and Disposition Center Davis-Monthan Air Force Base, Arizona It presents the Desert Storage Test Program conducted between January 1972 and February 1974 The best long term aircraft preservation process is discussed in terms of the storage related deterioration of aircraft Special emphasis is placed on environmental conditions inside the aircraft during storage GRA

N75-29462# Summa Corp, Culver City Calif Hughes Helicopters Div
FAILSAFE/SAFE-LIFE INTERFACE CRITERIA Final Report, Oct 1973 - Oct 1974
James F Needham Jan 1975 96 p refs
(Contract DAAJ02-74-C-0005 DA Proj 1F1-62808-A-170)
(AD-A006131 HH-74-141, USAAMRDL-TR-74-101) Avail NTIS CSCL 01/3

The purpose of this study was to develop rational failsafe/safe-life interface criteria for the design of helicopter structural components Present specifications containing design criteria were reviewed and deficient areas defined Rational design criteria were developed and are titled Damage-Tolerant Design Criteria Damage-tolerant design concepts are presented for various helicopter structural components They include redundant structure controlled fracture structure and failure indicating systems The Hughes OH-6A main rotor blade was selected as the structural component to establish the effects on life-cycle costs in designing to different structural criteria and using different damage-tolerant design concepts GRA

N75-29482# Hatfield Polytechnic (England)
THE EFFECT OF MEAN STRESS ON THE FATIGUE OF ALUMINUM ALLOYS
J Gott London Min of Defence 1974 107 p refs
(Contract MIN-DEF/PE-AT/2161/01/STR)
(S/T-Memo-9/74 BR34131) Avail NTIS HC $5 25

Fatigue tests were performed on notched specimens of three precipitation hardened aluminum alloys under constant amplitude loading The fatigue characteristics were obtained over a range of mean stress values which include tensile and compressive levels, comparisons were made between the three alloys and between the two notch factors used in the tests Correlation was obtained between alternating stress and the numbers of fatigue nuclei and evidence of two types of fatigue failure at certain stress levels is identified A useful method of presenting data at different mean stress values is introduced Author (ESRO)

N75-29483# Royal Aircraft Establishment Farnborough (England) Structures Dept
A SHORT STUDY OF THE EFFECT OF A PENETRANT OIL ON THE FATIGUE LIFE OF A RIVETED JOINT
P H ONeill and R J Smith London Aeron Res Council 1975 12 p Supersedes RAE-TR-73174 ARC-35284
(ARC-CP-1305 RAE-TR-73174, ARC-35284) Avail NTIS HC $3 25 HMSO 32P PHI $1 45

Laboratory fatigue tests on riveted joints, half of which had been impregnated with a water-displacing oil-based penetrant which is commonly being used in airline service to combat corrosion are described The results showed that the lives of the treated specimens were significantly shorter than those of the untreated specimens Further work however, would be necessary to determine the effect of the penetrant under more realistic conditions over a longer time Author (ESRO)

N75-29582# Air Force Weapons Lab Kirtland AFB N Mex
USAF AIRCRAFT POLLUTION EMISSION FACTORS AND LANDING AND TAKEOFF LTO CYCLES Final Report, 1 Jun - 1 Nov 1974
Dennis F Naugle and Steven R Nelson Feb 1975 50 p refs
(AD-A006239 AFWL-TR-74-303) Avail NTIS CSCL 13/2

Analysis of total pollution emissions from USAF aircraft requires basic data such as aircraft engine pollution emission factors and landing and takeoff (LTO) time-in-modes The report updates the list of measured pollution emission factors specific to each major USAF aircraft engine type Results of original research to define USAF LTO cycle times for nine operational modes per aircraft type are presented GRA

N75-29846* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
SIMULATION OF LARGE-SCALE DYNAMIC SYSTEMS
Leonard Roberts *In its* Large-Scale Dyn Systems 1975 p 7-21

CSCL 12B

The classes of large-scale dynamic systems are discussed in terms of modeling with emphasis on air transportation system modeling F O S

N75-29853* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

DIGITAL SIMULATION OF V/STOL AIRCRAFT FOR AUTOPILOT RESEARCH

L S Cicolani and George Meyer *In its* Large-Scale Dyn Systems 1975 p 163-183 refs

CSCL 12B

Simulations of V/STOL aircraft for autopilot research were introduced as examples of large scale systems A hierarchy of simulations was assembled and a modular organization was given to the simulations The dynamics of the system were subdivided into translational and rotational degrees of freedom based on the different frequencies at which significant variations in motion variables control forces and moments occur in two subsystems This is the basis of the autopilot partitioning into two smaller control problems Author

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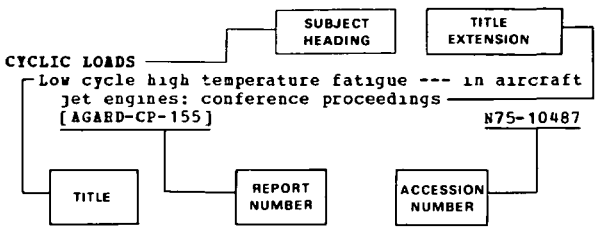

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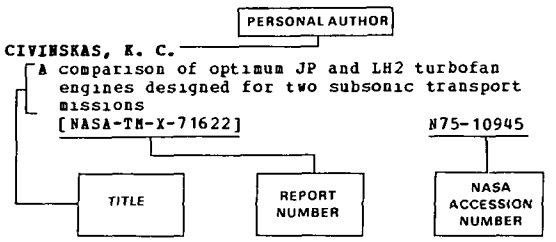

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