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AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY WITH INDEXES

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement (64)

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 November 1975 in

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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 288 reports, journal articles, and other documents originally announced in November 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.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances

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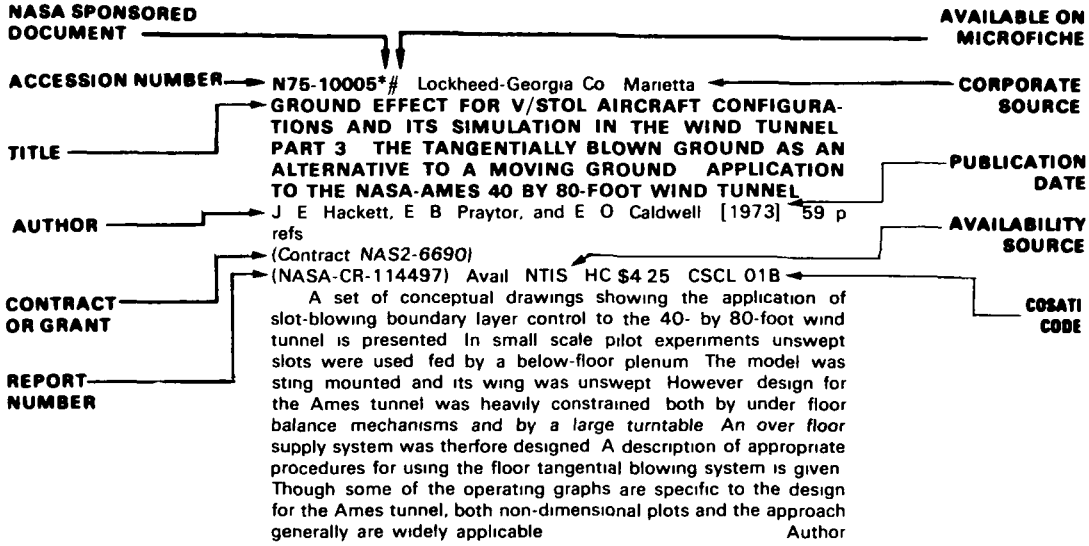

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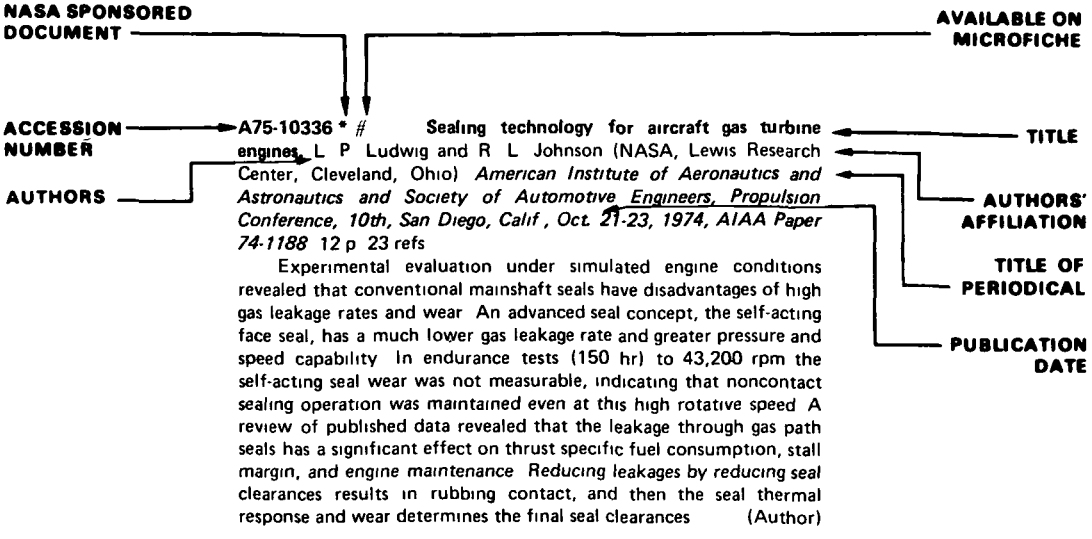

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 64) DECEMBER 1975

IAA ENTRIES

A75-41951 **Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1974 (Nederlandse Vereniging voor Luchtvaarttechniek, Jaarboek 1974)** Edited by F J Sterk Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1975 143 p In Dutch and English

Some selected topics in recent developments in the design of new aeronautical systems are discussed, including the development of rapid transit over water, considerations in the design of very large aircraft, nuclear-propelled aircraft, flight characteristics of very large subsonic transport aircraft in landing, aileron flutter of plastic sailplanes, and noise of small propeller aircraft

P T H

A75-41953 # **Some considerations on the design of very large aircraft** H Wittenberg (Delft, Technische Hogeschool, Delft, Netherlands) In Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1974 Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1975, p 3-1 to 3-16 7 refs

The paper reviews some of the fundamentals of the scaling laws for aircraft and shows the effects of increasing the size of present-day aircraft on take off/landing and cruising performance and on aircraft structure The square cube law is discussed, which states that aircraft weight - and thus flight loads - increases with the third power of the linear dimensions, but with geometrical similarity the cross-sectional areas only increase with the second power These considerations were applied in a parametric study of an aircraft having a gross weight roughly doubled in comparison with the Boeing 747B that is to be optimized for cruising performance by proper choice of wing- and thrust-loading Results of a preliminary design study for a mammoth turbofan-powered aircraft and a very large nuclear powered aircraft are presented P T H

A75-41954 # **The nuclear propelled aircraft** J C van der Sluis In Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1974 Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1975, p 4 1 to 4-19 5 refs

The major design, safety and economic problems in the realization of nuclear powered aircraft are discussed on the basis of a propulsion model in which the turbofan engines of the aircraft obtain heat for expanding the air passing through them from circulating helium heated by a central nuclear fission reactor One of the main technological problems remains the development of heat-exchanger creep-resistant materials The main safety criteria are complete freedom of movement in and around the aircraft, no release of radioactivity during normal operation, and no release of radioactivity in case of a major accident The third criterion represents the most formidable challenge The reactor shield assembly must withstand the shock of impact without rupture, melt-through of the containment vessel must be prevented, and the possibility of accidental critical mass must be eliminated It is shown that nuclear aircraft become economically more attractive as aircraft gross weight increases P T H

A75-41955 # **Flight characteristics of very large subsonic transport aircraft during landing approach (Vliegeigenschappen van zeer grote subsone transportvliegtuigen in de naderingsvlucht)** W P de Boer and H A Mooij (National Luchtvaartlaboratorium, Amsterdam, Netherlands) In Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1974 Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1975, p 5-1 to 5-17 16 refs In Dutch

The paper presents a study of projected handling qualities of future large (up to 1800 tons) subsonic aircraft during landing maneuvers Limits of the important parameters during symmetric and nonsymmetric movements are discussed, and the principles of 'direct-lift control' are set forth The concept of a 'control configured vehicle' is briefly discussed P T H

A75-41956 # **Aileron flutter in plastic sailplanes (Rolroerflutter bij kunststof zweefvliegtuigen)** P C Hensing (Delft, Technische Hogeschool, Delft, Netherlands) In Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1974 Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1975, p 6-1 to 6-11 In Dutch

The paper presents results of flutter calculations performed for the 'Standard Cirrus' sailplane based on resonance and damping characteristics of the aileron system Consideration of structural damping and dry friction in the aileron system shows that the wing of the aircraft is flutter-free in the normal speed range Two situations, namely, interaction between the first or second antisymmetric bending vibration and the aileron motion, were found to be safe for the 'Standard Cirrus', although they may be critical for similar aircraft with different mass and stiffness characteristics P T H

A75-41957 # **Some aspects of recent developments of the Fokker F28 transport aircraft** J H D Blom (Fokker-VFW, Schiphol-Oost, Netherlands) In Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1974 Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1975, p 7-1 to 7-15

The paper discusses two important aspects in the development of the F28 6000 aircraft improvement of take-off performance and noise reduction Take-off characteristics were improved by the development of full span slats with a low drag configuration and by increasing the wing span by 2 x 75 cm to reduce induced drag In assessing slat characteristics, a weighted balance between increments in maximum lift and in drag generated by the leading-edge devices was used as a criterion To lower external noise levels, absorbing linings were developed for the intake section of the nacelle, and linings were installed in the exhaust pipe aft of the engine Also, the gas stream was suitably changed by the use of a chuted nozzle to reduce gas stream noise P T H

A75-41958 # **Noise from light propeller aircraft (Geluid van lichte schroefvliegtuigen)** G J J Ruijgrok (Delft, Technische Hogeschool, Delft, Netherlands) In Nederlandse Vereniging voor Luchtvaarttechniek, Yearbook 1974 Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1975, p 8-1 to 8-18 15 refs In Dutch

A test program is described that sought to determine the sound levels produced by light (below 12,500 lb) propeller-driven aircraft Sound radiation patterns and spectral characteristics of the emitted sound from three aircraft types were measured for standard take-off and constant-altitude flight ICAO noise limits imposed on these aircraft are discussed P T H

A75-41969 **Determination of the three-dimensional transonic potential flow around wings and wing-body combinations by means of a relaxation technique (Berechnung der dreidimensionalen transsonischen Potentialstromung um Tragflugel und Tragflugel-Rumpf-Kombinationen mit einem Relaxationsverfahren)** S Rohlfs and R Vanino (Dornier GmbH, Friedrichshafen, West Germany) *(Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 7th, Kiel, West Germany, Sept 17-19, 1974) Zeitschrift fur Flugwissenschaften,* vol 23, July-Aug 1975, p 239-245 11 refs In German Bundesministerium der Verteidigung Contract No TR-720-R-7600-32-008

The two-dimensional relaxation method by Murman and Krupp is directly extended to the three-dimensional flow around wings and wing-body combinations The fundamental simplicity of the method can be maintained by solving the transonic potential equation for small perturbations equally by means of a cartesian coordinate grid in the physical flow field The boundary conditions of the wing are given on the wing center plane and the boundary conditions of the body on an infinitely long prismatic fuselage The flow in the far field is calculated using Klunker's analytical solution Various sample calculations effected on wings are compared with wind tunnel results and other theoretical calculations, in addition, the calculation of a wing with supercritical profile is verified A simple sweptback wing-body combination is calculated with and without lift (Author)

A75-41970 **Design and wind-tunnel measurement of a wing-body combination with supercritical airfoil (Entwurf und Windkanalmessung einer Flugel-Rumpf-Kombination mit uberkritischem Profil)** A Gustavsson (Forsvarsdepartmentet, Flygtekniska Forsoksanstalten, Bromma, Sweden) and R Vanino (Dornier GmbH, Friedrichshafen, West Germany) *(Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 7th, Kiel, West Germany, Sept 17-19, 1974) Zeitschrift fur Flugwissenschaften,* vol 23, July-Aug 1975, p 257-262 8 refs In German Bundesministerium der Verteidigung Contract No TR-720-R-7600-32-008

A wind-tunnel model with a wing of moderate aspect ratio and a supercritical airfoil was designed and high-speed measurements were conducted The principles of design are illustrated and the experimental results are discussed For the wing design a relaxation procedure for the calculation of the supercritical airfoil flow and a standard procedure for the calculation of the compressible wing-body flow were used The wind-tunnel tests comprise six-component measurements, buffeting measurements as well as oil flow and Schlieren pictures Comparisons are made with a reference wing with a conventional airfoil combined with a cylindrical and a waisted body The wing with supercritical airfoil gives an increase of the drag-rise Mach number, shifting of buffet onset to higher lift coefficients and drag reduction for high-lift coefficients The body waisting leads to a considerable increase of the drag-rise Mach number for the non-lifting case (Author)

A75-42072 * # **Potential and viscous flow prediction in V/STOL propulsion system inlets** N O Stockman (NASA, Lewis Research Center, Cleveland, Ohio) *U S Naval Air Systems Command, Workshop on Prediction Methods for Jet V/STOL Propulsion Aerodynamics, Arlington, Va, July 28-31, 1975, Paper* 15 p 12 refs

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

A75-42073 * # **Summary of model VTOL lift fan tests conducted at NASA Lewis Research Center** J H Diedrich (NASA, Lewis Research Center, Cleveland, Ohio) *U S Naval Air Systems Command, Workshop on Prediction Methods for Jet V/STOL Propulsion Aerodynamics, Arlington, Va, July 28-31, 1975, Paper* 23 p 9 refs

Early in this decade three model VTOL lift fan studies were conducted in the NASA Lewis Research Center's 9- by 15-foot V/STOL wind tunnel The first experiment consisted of crossflow tests of a 15-inch diameter fan installed in a two-dimensional wing The wing was then 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 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 (Author)

A75-42174 **Why the F-16 (Perché l'F-16)** P Corsini *Rivista Aeronautica,* vol 51, May-June 1975, p 23 58 In Italian

The paper discusses the technical, economic, and operational reasons that led to the U S A F adopting the YF-16 as its new light fighter These are discussed in the light of new Pentagon orientations with regard to aeronautical systems The consequences of the Air Force's decision for European aviation are examined P T H

A75-42183 * **The numerical simulation of low frequency unsteady transonic flow fields** W F Ballhaus and H Lomax (NASA, Ames Research Center, Moffett Field, Calif) In International Conference on Numerical Methods in Fluid Dynamics, 4th, Boulder, Colo, June 24-28, 1974, Proceedings New York, Springer-Verlag New York, Inc, 1975, p 57-63

The lowest order approximation to the Euler equations for unsteady, transonic flow about a thin airfoil is considered and a semiimplicit difference scheme is applied to a simplified governing equation which is a suitable modification of this approximation for low-frequency motion In another approach the approximation first considered is retained as the governing equation and a semiimplicit difference scheme is employed The computed results obtained in both cases are discussed G R

A75-42185 **Flat slender delta wings in supersonic stream at small angles of attack** A P Bazzhin In International Conference on Numerical Methods in Fluid Dynamics, 4th, Boulder, Colo, June 24-28, 1974, Proceedings New York, Springer-Verlag New York, Inc, 1975, p 69-78 7 refs

The most probable flow pattern over the wings at a moderate free stream Mach number is one in which the conical bow wave is attached to the tip of the wing only Difficulties concerning a solution based on the full nonlinear system of gasdynamic equations are partly related to the computation of the flowfield in the nearest vicinity of the leading edge A description is given of some results which characterize the inner structures of flows over flat delta wings G R

A75-42194 * **High Reynolds number transonic flow simulation** G S Deiwert (NASA, Ames Research Center, Moffett Field, Calif) In International Conference on Numerical Methods in Fluid Dynamics, 4th, Boulder, Colo, June 24-28, 1974, Proceedings New York, Springer-Verlag New York, Inc, 1975, p 132-137

A code has been developed for simulating high Reynolds number transonic flow fields of arbitrary configuration An explicit finite-difference method with time splitting is used to solve the time-dependent equations for compressible turbulent flow A non-orthogonal computational mesh of arbitrary configuration facilitates the description of the flow field The code is applied to simulate the flow over a two-dimensional 18 percent thick circular-arc biconvex airfoil at zero angle of attack for several different Reynolds numbers and a free-stream Mach number of 0 775 (Author)

A75-42200 **A numerical procedure in the hodograph plane for the study of transonic flow past wing profiles** B Gabutti (Pavia, Universita, Pavia, Italy), G Geymonat, and S Nocilla (Torino,

Politecnico, Turin, Italy) In International Conference on Numerical Methods in Fluid Dynamics, 4th, Boulder, Colo , June 24-28, 1974, Proceedings (A75-42176 21-34) New York, Springer-Verlag New York, Inc , 1975, p 176-180 Research supported by the Consiglio Nazionale delle Ricerche

A75-42207 **Leading edge separation from non-conical slender wings at incidence.** I P Jones (East Anglia, University, Norwich, England) In International Conference on Numerical Methods in Fluid Dynamics, 4th, Boulder, Colo , June 24-28, 1974, Proceedings New York, Springer-Verlag New York, Inc, 1975, p 225-232 7 refs Ministry of Defence Contract No. AT/2162/05

A numerical method is proposed for evaluating the behavior of a flow past flat plate slender wings at incidence At the leading edges of such a wing the boundary layers on the upper and lower surfaces meet and coalesce to form a vortex sheet which spirals into a vortex core situated above the wing The method for advancing the solution downstream through successive cross-flow planes is based on the Crank-Nicolson marching procedure Assumptions are made that the flow is effectively inviscid, that the vorticity in the fluid is condensed onto vortex sheets which emanate from the leading edges, that the secondary separation induced under the primary vortex is negligible, and that the slender body theory of Munk, Jones, and Ward is applicable An intrinsic coordinate system is adopted in each cross-flow plane to describe the initially unknown sheet shape As an example, the method is applied to wings of two different basic shapes S D

A75-42215 **Difference methods for transonic flows about airfoils** A A Mirin (California, University, Livermore, Calif) and S Z Burstein (New York University, New York, N.Y.) In International Conference on Numerical Methods in Fluid Dynamics, 4th, Boulder, Colo , June 24-28, 1974, Proceedings New York, Springer-Verlag New York, Inc, 1975, p 277-286 Contract No AT(11-1)-3077

Solutions to the problem of steady transonic flow of an inviscid perfect gas past plane lifting airfoils are computed using a time dependent formulation The steady solution to the system of hyperbolic partial differential equations is obtained as the asymptotic limit of flow for large times A coordinate system, which makes use of a conformal map of the interior of the unit circle onto the exterior of the airfoil, is used The conservation laws are expressed in terms of polar coordinates on the interior of the unit disc and are solved using a second order accurate method To extend the numerical solution to the boundary of the unit disc the method of characteristics is used (Author)

A75-42225 **Some results using relaxation methods for two- and three-dimensional transonic flows.** W Schmidt, S Rohlfs, and R Vanino (Dornier GmbH, Friedrichshafen, West Germany) In International Conference on Numerical Methods in Fluid Dynamics, 4th, Boulder, Colo , June 24-28, 1974, Proceedings New York, Springer-Verlag New York, Inc , 1975, p 364-372 11 refs Bundesministerium fur Verteidigung Contract No T/R-720/R-7600-32-008

In the past, relaxation methods have been demonstrated to be a powerful numerical tool for obtaining steady-state solutions to the two- and three-dimensional transonic potential equations The basic numerical procedure accounts for the mixed elliptic-hyperbolic character of the governing equations by using a mixed finite-difference scheme The general procedure is to employ centered differences when the flow is locally subsonic and one sided differences when it is locally supersonic Bailey and Ballhaus (1972) extended the mixed elliptic-hyperbolic relaxation method to the inviscid transonic small disturbance equation in three dimensions In this paper, we use a similar approach, considering transonic flow over thin lifting wings with sweep, taper and curved leading edges and about nonlifting and lifting wing-body combinations (Author)

A75-42231 **Studies of free buoyant and shear flows by the vortex-in-cell method** J A L Thomson and J C S Meng (Physical Dynamics, Inc., Berkeley, Calif) In International Conference on Numerical Methods in Fluid Dynamics, 4th, Boulder, Colo , June 24-28, 1974, Proceedings New York, Springer-Verlag New York, Inc., 1975, p 403-416 11 refs

The vortex-in-cell (VIC) method is a numerical method which combines the concepts of the particle-in-cell method, Green's function, and the fast Fourier transform The formulation of the problem for inviscid fluids is discussed along with some features of the VIC method and numerical computations with the discrete vortex model Attention is given to the rise of a buoyant cylinder (thermal), the Saffman-Taylor instability, the transport of aircraft trailing vortices, and the gravity current G R.

A75-42313 # **A method for determining the force characteristics of an airfoil of finite span (Ob odnom metode opredeleniia silovykh kharakteristik kryla konechnogo rozmakha)** M D Martynenko and V A Savenkov (Belorusskii Gosudarstvennyi Universitet, Minsk, Belorussian SSR) *Akademiia Nauk BSSR, Doklady,* vol 19, July 1975, p 585-587 In Russian

Formulas are presented for determining the lift and pressure moments acting on an airfoil of finite span These are obtained from the limiting values at infinity of the derivatives of the harmonic function expressing the potential of the rate of absolute fluid motion The formulas are applied to a circular airfoil of finite span, and the results are shown to coincide with those obtained by Kochin (1949) F G M

A75-42505 **Approval of flight simulator flying qualities** D P Davies (Civil Aviation Authority, London, England) *Aeronautical Journal,* vol 79, July 1975, p 281-297

The present paper deals with simulators for civil fixed-wing transport aircraft above 20,000 kg maximum weight Approval procedures in the United Kingdom are summarized, the present level of simulator flying qualities is evaluated, and some elementary advice on simulation in general is provided It is concluded that flight simulators are not nearly up to the standards they claim to measure up to, and that even if they do improve in the future, training should include a solid period of actual flight practice S J M

A75-42506 **Paying for design** D J Leech and P M Smart (Swansea, University College, Swansea, Wales) *Aeronautical Journal,* vol 79, July 1975, p 305-309

Results of a simulation of the design process are presented, this simulation takes into account the effects of chance in a particular design environment In particular, the design effort expended on tendering and the probability of getting an order are investigated The analysis deals mainly with the situation believed to obtain among accessory manufacturers S J M

A75-42656 **The problem of forced fittings. I - The loading process.** R M Potter (USAF, Applied Mathematics Research Laboratory, Wright-Patterson AFB Ohio) and T W Ting (Illinois, University, Urbana, Ill) *Archive for Rational Mechanics and Analysis,* vol 58, no 1, 1975, p 77-94 27 refs NSF Grants No GP 33174X2, No MPS-75-07118

Certain constitutive relations involving linear strain tensor, Cauchy stress, stress deviator, and the tensor-valued linear operator representing Hooke's law are applied to the technique of fitting with proper interference The geometrically simple case of a flat ring bounded by two circles is considered, the problem becomes one of determining the mechanical effect when a large rigid mandrel is slowly forced into the hole of the ring and the effect of the permanent deformation when the mandrel is removed Purely elastic, completely plastic, and elastic-plastic loading are treated S J M

A75-42684 **Oil support helicopters** S Broadbent *Flight International*, vol 108, Aug 14, 1975, p 229-234

Several designs and currently employed models of oil-support helicopter for use in the North Sea are described The Sikorsky S-61N and S-58T are two of the most important models Questions of small operators, air traffic control, night flying restrictions, and future equipment are considered Performance data for about a dozen different craft are tabulated and compared S J M

A75-42701 # **Turbulent boundary layer noise in the interior of aircraft operating at varying altitudes** D E Bray (Oklahoma, University, Norman, Okla) *Acoustical Society of America, Meeting, 89th, Austin, Tex , Apr 7-11, 1975, Paper* 19 p 12 refs

The noise generated by the turbulent boundary layer around the fuselage of a passenger aircraft is known to affect most of the passengers The origin of this noise is examined, along with the effects of static and dynamic air properties on the noise levels A correlation of noise with data collected during regularly scheduled aircraft flights is revealed It is shown that changes in the turbulent boundary layer noise in commercial aircraft operating at varying altitudes vary according to the density change squared and the local sound speed change to the first power S D

A75-42703 * # **The effect of air flow, panel curvature, and internal pressurization on field-incidence transmission loss** L R Koval (Missouri, University, Rolla, Mo) *Acoustical Society of America, Meeting, 89th, Austin, Tex , Apr 7-11, 1975, Paper* 25 p 19 refs Grant No NsG-1050

In the context of sound transmission through aircraft fuselage panels, equations for the field-incidence transmission loss (TL) of a single-walled panel are derived that include the effects of external air flow, panel curvature, and internal fuselage pressurization These effects are incorporated into the classical equations for the TL of single panels, and the resulting double integral for field-incidence TL is numerically evaluated for a specific set of parameters (Author)

A75-42710 * # **Influence of multitube mixer nozzle geometry on CTOL-OTW jet noise shielding** U von Glahn and D Groesbeck (NASA, Lewis Research Center, Cleveland, Ohio) *Acoustical Society of America, Meeting, 89th, Austin, Tex , Apr 7-11, 1975, Paper* 20 p

Acoustic shielding benefits for CTOL over-the-wing (OTW) applications were obtained experimentally with various multitube nozzles using a simple board to represent a wing Eight nozzles consisting of three to thirteen 2 36-cm diameter tubes were tested The nozzles included single and double rings of tubes Shielding surface lengths of 15 0 to 54 4 cm were used with each nozzle Far-field noise data were obtained at 90 deg from the jet axis and with a nominal jet exhaust velocity of 200 m/sec The jet noise shielding benefits for the nozzles with double rows of tubes, in terms of sound pressure level spectra, are correlated successfully as a function of an earlier developed parameter for nozzles with a single ring of tubes that includes consideration of the number of tubes and the local peak velocity in the flow field at the trailing edge of the shielding surface (Author)

A75-42711 * # **Analysis of ground reflection of jet noise obtained with various microphone arrays over an asphalt surface** J H Miles (NASA, Lewis Research Center, Cleveland, Ohio). *Acoustical Society of America, Meeting, 89th, Austin, Tex , Apr 7-11, 1975, Paper.* 43 p 19 refs

Ground reflection effects on the propagation of jet noise over an asphalt surface are discussed for data obtained using a 33 02 cm (13-in) diameter nozzle with microphones at several heights and distances from the nozzle axis Analysis of ground reflection effects is accomplished using the concept of a reflected signal transfer function which represents the influence of both the reflecting surface and the atmosphere on the propagation of the reflected signal in a mathematical model The mathematical model used as a basis for the computer program was successful in significantly reducing the ground reflection effects The range of values of the single complex number used to define the reflected signal transfer function was larger than expected when determined only by the asphalt surface This may indicate that the atmosphere is affecting the propagation of the reflected signal more than the asphalt surface Also discussed is the selective placement of the reinforcements and cancellations in the design of an experiment to minimize ground reflection effects (Author)

A75-42712 * # **Effects of three activities on annoyance responses to recorded flyovers** W J Gunn, W T Shepherd (NASA, Langley Research Center, Hampton, Va), and J L Fletcher (Memphis State University, Memphis, Tenn) *Acoustical Society of America, Meeting, 89th, Austin, Tex , Apr 7-11, 1975, Paper* 47 p 9 refs NASA-sponsored research

Subjects participated in an experiment in which they 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 5dB 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 Furthermore, not all subjects found the aircraft sounds to be annoying (Author)

A75-42713 * # **Interior noise considerations for powered-lift STOL aircraft** C K Barton (NASA, Langley Research Center, Hampton, Va) *Acoustical Society of America, Meeting, 89th, Austin, Tex , Apr 7-11, 1975, Paper* 18 p 15 refs NASA-sponsored research

Powered-lift configurations which are currently under development for future use on STOL aircraft involve impingement of the jet engine exhaust onto wing and flap surfaces Previous studies have suggested that the impinging jet produces higher noise levels at lower frequencies than does the jet alone These higher levels, together with the close proximity of the engine and flap noise sources to the fuselage sidewall, suggest that the noise levels in these aircraft may be high enough to interfere with passenger comfort To investigate this possibility, interior noise levels were estimated for both an upper surface blown (USB) and an externally blown flap (EBF) configuration This paper describes the procedure used to estimate the interior noise levels and compares these levels with levels on existing jet aircraft and on ground transportation vehicles These estimates indicate high levels in the STOL aircraft, therefore, areas of possible improvements in technology for control of STOL interior noise are also discussed (Author)

A75-42972 # **Technology, efficiency, and future transport aircraft** R S Shevell (Stanford University, Stanford, Calif) *Astronautics and Aeronautics*, vol 13, Sept 1975, p 36-42 9 refs

It is pointed out that the success of a new aircraft design is largely determined by its service/cost index Difficulties concerning an acceptance of the SST and STOL are partly related to a high fuel consumption Improved transonic airfoils and advanced composites promise to both improve economics and conserve fuel The development of rapid-reponse automatic control systems for maintaining static and dynamic stability is discussed and the prospects of various developments in aircraft technology are evaluated It is believed that economic, environmental, and technological difficulties will make unlikely a substantial early impact on air transportation from laminar-flow aircraft, nuclear aircraft, STOL, or the SST G R

A75-43005 **Austerity dictated simple YC-15 design** D E Fink *Aviation Week and Space Technology,* vol 103, Sept 1, 1975, p 57, 60-63

Details of the design of the YC-15 advanced medium STOL transport (AMST) aircraft are discussed Data on capacity, dimensions, wing area, landing gear, engines, performance, take-off field length, and design range are presented Large flap actuators are housed in streamlined fairings beneath the wing The engine exhaust nozzles mix cooling ambient air with hot core flow One of the main elements in the YC-15 design is the large span flap system The YC-15 is designed to accommodate at least three advanced turbofan engines Access to the cargo compartment is provided by a large upward-swinging door and ramp with integral toes S J M

A75-43031 **Noise control of aircraft engines** R Lee and R E Motsinger (General Electric Co , Aircraft Engine Group, Cincinnati, Ohio) *Noise Control Engineering,* vol 5, July-Aug 1975, p 18-23 5 refs

Noise levels of current aircraft models are examined, taking into account technological advances concerning engine noise reduction made in connection with the development of the CF6 engine The short takeoff and landing (STOL) projected noise status relative to the CTOL status is shown in a table The noise characteristics of various aircraft engine components are discussed along with suitable methods of noise reduction Attention is given to the fan inlet, the conventional inlet, the accelerating/hybrid inlet, inlet noise reduction by shielding, the exhaust, the turbine, the combustor, and the jet G R

A75-43032 **Noise - How much is too much** H E von Gierke (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, Ohio) *Noise Control Engineering,* vol 5, July-Aug 1975, p 24-34 28 refs

Studies which have been conducted to obtain a basis for an effective environmental noise control program are considered and a method designed for measuring and assessing environmental noise is presented The identification of safe levels for hearing conservation is discussed and attention is given to the identification of environmental noise levels with respect to activity interference and annoyance It is recommended that agreement should be reached concerning a common descriptor of environmental noise G R

A75-43281 **F-18 US Navy Air Combat Fighter** C Gilson *Flight International,* vol 108, Aug 21, 1975, p 259-263

The paper describes the Navy's search for a replacement of the F-4 and A-7, and then gives the main characteristics of the F-18 finally chosen Development will proceed along the lines of revising the YF-17 according to Navy specifications The F404 afterburning powerplant will be an upgrading of the YJ101 Assuming full-scale development of both airframe and engine is started in September, 1975, first flight of an F-18 will be in 1978 P T H

A75-43549 # **Suggestions for modernizing a helicopter cockpit (Propozycje unowoczesnienia układu kabiny smiglowca)** S Wielgus (Instytut Lotnictwa, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 30, July-Aug 1975, p 29 32 In Polish

A first-generation helicopter cockpit is described, and means of modernizing its layout (such as shifting the pilot seat from the traditional left side to the right side) are studied A number of instruments (such as an automatic flight control system and a VOR/ILS radio navigation system) that should be introduced in future helicopters are noted V P

A75-43550 # **Some criteria for selecting filters for aircraft and special hydraulics (Niektore kryteria doboru filtrow dla hydrauliki lotniczej i specjalnej)** J Zmihorski (Instytut Lotnictwa, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 30, July-Aug 1975, p 32-36 25 refs In Polish

The types of contamination caused by ingredients of hydraulic fluids in aircraft hydraulic systems, and the effects of contamination on system performance are studied The types of filter used in pressurized and suction mains are examined, and the selection of the proper filter to meet the contamination level requirements for specific conditions is discussed V P

A75-43579 # **Aerodynamic analysis of different flight attitudes of conventional aircraft. XV (Flugmechanische Analyse verschiedener Flugzustände konventioneller Flugzeuge XV)** F Seidler (Dresden, Hochschule fur Verkehrswesen, Dresden, East Germany) *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol 11, no 3, 1975, p 173-188 In German

Wings with finite span are considered, taking into account the origin of the induced drag and the effective parameters of the induced drag The quantitative determination of the induced drag is discussed, giving attention to general relations and questions regarding the induced drag in the case of an elliptic lift distribution An investigation is conducted concerning the effect of the angle of attack or the lift on the induced angle of attack The effect of the aspect ratio on the induced angle of attack and the coefficient of the induced drag is also explored G R

A75-43809 # **Principles and problems of designing aircraft structures made of composite materials (O printsipakh i problemakh proektirovaniia aviakonstruktsii iz kompozitsionnykh materialov)** V E Gaidachuk *Samoletostroenie Tekhnika Vozdushnogo Flota,* no 36, 1975, p 51-56 16 refs In Russian

The design of aircraft structures calls for meeting the tactical and engineering requirements with minimum cost and amortization and with maximum design reliability Problems associated with the development of aircraft structures made of composites are analyzed, with particular reference to the factors involved in the cost of aircraft structures An analysis of the characteristics of fiber-reinforced composites makes it possible to recommend a number of techniques for designing aircraft composite components These techniques include monolithic production processes and differential and synthetic methods for optimal reinforcement with minimum composite weight S D

A75-43811 # **Train-gauge technique for the experimental determination of displacements of aircraft structural elements (Metodika eksperimental'nogo opredeleniia peremeshchenii elementov aviakonstruktsii s pomoshch'iu tenzodatchikov)** A I Makeev, A A Kirpikin, V V Pisarenko, B I Skopintsev, L A Trishina, and D A Pinchuk *Samoletostroenie Tekhnika Vozdushnogo Flota,* no 36, 1975, p 59-65 In Russian

A75-43814 # **Realization of random loads in tests of aircraft structure lifetimes (O realizatsii sluchainykh nagruzok pri resursnykh ispytaniiakh aviatsionnykh konstruktsii)** N G Belyi, V S Dubinskii, E A Kaliaev, and S N Luk'ianenko *Samoletostroenie Tekhnika Vozdushnogo Flota,* no 36, 1975, p 82 84 In Russian

A75-43815 # **Selection of a second-order rig (K voprosu o vybore osnastki vtorogo poriadka).** Iu A. Boborykin, V V Knigin, N M Parkhomenko, and A N Bereziuk *Samoletostroenie. Tekhnika Vozdushnogo Flota,* no 36, 1975, p 104-109 In Russian

The most common accuracy characteristics of airframe dimensions are the deviations of the outer contours of the airframe elements and the imperfections in the couplings Solution of problems concerning quality production is determined by accepted techniques and ways of securing interchangeability of components One of the basic means of providing interchangeability in assembly production is shown to be a second-order rig which is chosen according to the required tolerances and production costs Different component linking techniques are discussed S D.

A75-43816 # **Boring of holes in parts made of titanium alloys (Rastachivanie otverstii v detaliakh iz titanovykh splavov)** V V Shpakovskii and V N Malets *Samoletostroenie Tekhnika Vozdushnogo Flota*, no 36, 1975, p 109-112 In Russian

Results are presented for an experimental study of the durability of hard-metal cutting tools used in finishing-stage boring of holes with different diameters (1 to 10 mm) in parts made of the following titanium alloys VT-0, VT-1, VT-2, VT-3, VT-4, VT-5, and OT-4 The durability of cutting tools is evaluated in terms of cutting speed and tip geometry and material It is found that highest durability is attained with cutting tools prepared from hard-metal VK6K with a definite tip geometry and a cutting speed ranging from 40 to 50 m/min. S D

A75-43817 # **Design of the load-carrying structure of an aircraft by a finite-element force method with division into substructures (K raschetu silovoi konstruktsii letatel'nogo apparata konechnoelementnym metodom sil s raschleneniem na podstruktury)** V D Pervak and V M Riabchenko *Samoletostroenie Tekhnika Vozdushnogo Flota*, no 36, 1975, p 120-127 5 refs In Russian

The paper discusses the design of an aircraft frame by a finite-element force method involving the decomposition of the airframe into elementary substructures Particular attention is given to the evaluation of the self-balanced localized stress state of joints and to simplifications resulting from the construction of the matrices of the constitutive canonical equations These simplifications provide a significant reduction in the computational time on a computer All the discussion and calculations are limited to the case of a transport aircraft S D

A75-43903 **Plane sub-critical flow past a lifting aerofoil** D B Ingham (Leeds University, Leeds, England) *Institute of Mathematics and Its Applications, Journal*, vol 16, Aug 1975, p 73-80

The investigation reported is concerned with a modification of the numerical method used by Sells (1968) in his study of steady two-dimensional compressible flow past an airfoil The modification has the objective to obtain more accurate results without a substantial increase in computer storage or time requirements A conformal transformation is used to obtain more mesh points near any particular point in space where more information is needed An investigation is conducted of the behavior of the pressure coefficient in the vicinity of near-sonic flow G R

A75-43959 # **A new method of calculating the aerodynamic loading distribution on the blades of a translating helicopter rotor** S K Gupta (Pratt and Whitney Aircraft of Canada, Ltd , Longueuil, Quebec, Canada) and J H T Wade (McMaster University, Montreal, Canada) *CASI Transactions*, vol 8, Mar 1975, p 1-9 15 refs

A new computational model for the calculation of blade loading in forward flight is presented The model eliminates the use of the much disputed sectional aerodynamic data Considerations of the rotor trailing wake also do not explicitly enter the analysis The assumption of the validity of the 'Independence Principle' has been dropped The blades are replaced by doublet sheets, and the governing integral equation is obtained from acceleration potential considerations The integral equation, itself, is solved numerically Computations are made for a full scale 15-foot diameter NASA model rotor at an advance ratio of 0 29 The computed blade loadings are in good agreement with those obtained experimentally by NASA in a wind tunnel (Author)

A75-43968 **Future engines and fuels** J Grey (American Institute of Aeronautics and Astronautics, Inc , New York, N Y) and E C Simpson (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio) *Exxon Air World*, vol 27, no 4, 1975, p 91-95

The variable-cycle engine and the supersonic-combustion ramjet (for hypersonic aircraft) are discussed, with emphasis on the first topic Flexible variable-cycle engines could power high-thrust STOL operations and low-noise takeoffs and landings while still permitting high-speed economical cruise, others could permit a single airplane to fly efficiently at both subsonic and supersonic speeds The supersonic-combustion ramjet will find application farther in the future than the variable-cycle engine, it is the only envisoned air-breathing engine which could operate effectively above Mach 5 The use of hydrogen as a fuel and the need for rejuvenation of the nuclear aviation power development effort are also discussed S J M

A75-44018 # **Foundations for a theory of the ring airfoil in axisymmetric shear-flow (Grundlagen zu einer Theorie des Ringflugels in axialsymmetrischer Scherstromung)** J Weissinger and B Overlach (Karlsruhe, Universitat, Karlsruhe, West Germany) *Zeitschrift fur angewandte Mathematik und Mechanik*, vol 55, July-Aug 1975, p 413-421 8 refs In German

Three-dimensional flows with axisymmetric characteristics can be described with the aid of the stream function and cylindrical coordinates The considered condition makes it possible to apply the methods of the two-dimensional theory A flow problem involving an axisymmetric ring airfoil is examined with the aid of the singularity approach developed by Weissinger (1956, 1957) The principles for the theoretical solution of the problem are discussed A few simple examples are presented to illustrate the characteristics of the derived relations G R

A75-44099 # **Some aspects of studying the heat conditions of flight vehicles in the design and testing phase (Nekotorye voprosy issledovaniia teplovykh rezhimov letatel'nykh apparatov pri proektirovanii i eksperimental'noi otrabotke)** B M Pankratov *Inzhenerno-Fizicheskii Zhurnal*, vol 29, July 1975, p 133-139 In Russian

The various heat- and mass-transfer processes that must be carefully considered in the design phase of an aircraft, rocket, or spacecraft are discussed, and the use of inverse heat conduction problems in the design and testing of such vehicles is examined It is shown that algorithms for solving various inverse problems play an important part in the mathematical theory of automatic heat data processing systems V P

A75-44107 # **Visual simulation for visual flight conditions (Sichtsimulation fur Sichtflugbedingungen)** E Vogl (Industrieanlagen-Betriebsgesellschaft mbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Ortung und Navigation, Nationale Tagung uber Simulation im Dienste des Verkehrs, Bremen, West Germany, Apr 15-17, 1975, Paper 3 5* 16 p In German

The development of a simulator for the air to-air combat operations of two fighters is reported The device makes it possible for two pilots to be engaged in a simulated combat in real time against each other It is attempted to provide for both pilots environmental conditions which are as close as possible to those of the actual combat The environmental conditions provided include the pilot's seat in the cockpit, the control stick, the entire instrumentation of the cockpit, and a presentation of the visual and auditory aspects of the combat Particular attention is given to the approaches used to provide for the pilot a view which corresponds to that which the pilot will have in an actual combat, taking into account the appearance of the adversary and the other environmental factors G R

A75-44111 # **Digital aircraft simulation in real-time with the aid of a small computer (Digitale Flugzeugsimulation in Echtzeit auf Kleinrechner)** K P Holzhausen (Forschungsinstitut fur Anthropotechnik, Meckenheim, West Germany) *Deutsche Gesellschaft fur Ortung und Navigation, Nationale Tagung uber Simulation im Dienste des Verkehrs, Bremen, West Germany, Apr 15 17, 1975, Paper 1 3* 22 p 12 refs In German

The hardware requirements for an aircraft simulating system are considered along with the software needed for a flight simulator and

approaches for reducing the software requirements in the case of specific test objectives The employment of simplified simulation procedures in small research simulators is illustrated with the aid of an example involving a simulating system for the executive jet HFB 320 Hansa Data obtained with the aid of the simulator are compared with actual flight data G R

A75-44188 * Thermochemical characterization of aircraft interior panel materials D A Kourtides, J A Parker, and W J Gilwee, Jr (NASA, Ames Research Center, Moffett Field, Calif.) *Journal of Fire and Flammability*, vol 6, July 1975, p 373-391 17 refs Contract No NAS2-8244

This paper discusses the thermochemical characterization of the state-of-the-art aircraft interior materials and, specifically, polyvinyl fluoride used currently as a decorative surface in aircraft interiors Characterization includes (1) polymer characterization, (2) thermochemical studies to measure the effect of environment upon polymer decomposition, and (3) quantitative analysis of the volatile products from pyrolysis, oxidative degradation, and flaming combustion of the polymer In addition this paper describes the processing and evaluation of composite sidewall panels fabricated from currently used and advanced fire-resistant materials Laboratory test methodology used to qualify candidate composite materials includes thermochemical characterization of the polymeric compounds and evaluation of the completed panel assemblies for flammability, fire endurance, and smoke evolution The use of these test methods will be discussed in comparing advanced composites consisting of phenolphthalein polycarbonate, bismaleimide-glass, polyamide, and polyquinoxaline, with conventional baseline materials (Author)

A75-44202 Annual Reliability and Maintainability Symposium, Washington, D C , January 28-30, 1975, Proceedings Symposium sponsored by IEEE, AIIE, ASQC, IES, SOLE, AIAA, and ASME New York, Institute of Electrical and Electronics Engineers, Inc , 1975 629 p $18

The subjects considered are related to assurance technology payoffs, nuclear systems safety, maintainability technology, the 1975 system effectiveness task status report, life cycle cost analysis, reliability testing and evaluation, electronic controls for aircraft engines, human performance reliability modeling, and mathematical modeling Attention is also given to maintainability analyses, the direct method in sequential analysis, the reliability of major mechanical systems, aspects of contracting and management, power systems reliability, software reliability, the reliability of mechanical parts and subsystems, and modeling for measures of effectiveness G R

A75-44203 Maintainability estimating relationships D F Harmon, P A Pates, and D Gregor (Northrop Corp , Hawthorne, Calif) In Annual Reliability and Maintainability Symposium, Washington, D C , January 28 30, 1975, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 18-25

Projecting realistic Maintainability (manhour/flight hour) estimates for tactical fighter aircraft during conceptual and development design phases is a continuing problem for the Department of Defense The approach to solving this problem is based on the use of correlation analysis to develop a model which relates historical maintenance data to design/performance parameters The discussion of the model development includes (1) compilation of a maintenance characteristics data base for tactical aircraft, (2) selection of valid design/performance parameters, and (3) correlation of maintenance characteristics with the design/performance parameters and a statistical validation of the results A Swedish Air Force Tactical fighter, the SAAB Viggen, is used to illustrate the model capability The maintainability model provides realistic projections of maintenance requirements and is sensitive to design parameters normally used during the conceptual and development phase of aircraft design (Author)

A75-44204 Maintainability payoffs during weapon-system test - The value of appropriate testing J R Nelson (Rand Corp , Washington, D C) In Annual Reliability and Maintainability Symposium, Washington, D C , January 28-30, 1975, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 26-29

A summary of lessons learned from a decade of experience in examining developmental and operational field tests of aircraft weapon systems is presented An approach to reconcile design-to-cost and life-cycle cost in the context of maintainability payoffs during weapon-system test is discussed (Author)

A75-44205 Viggen aircraft maintainability - Maintainability evaluation of the engine installation for the Viggen aircraft L E *Dahlberg (Systecom AB, Bromma, Sweden) and* S E *Westlund* (Volvo Flygmotor AB, Trollhattan, Sweden) In Annual Reliability and Maintainability Symposium, Washington, D C , January 28-30, 1975, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 30-39

The evaluation reported is concerned with reliability and maintainability predictions and a maintenance and product support analysis A repair/discard analysis was conducted to obtain a basis for the establishment of a maintenance and support plan Questions regarding the need of preventive maintenance are discussed along with criteria for engine overhaul in combination with engine repair Problems concerning the 'best' turn around time at depot level for overhauls are examined and attention is given to the computation of spare engines G R

A75-44208 Diagnostic engine monitoring for military aircraft. K. R Hamilton (USAF, Turbine Engine Components Branch, Wright-Patterson AFB, Ohio) and M H Chopin (USAF, Aeronautical Systems Div , Wright-Patterson AFB, Ohio) In Annual Reliability and Maintainability Symposium, Washington, D C , January 28-30, 1975, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 88-91 15 refs

The concepts for diagnostic monitoring differ for each aircraft type and must conform to mission requirements and expected usage factors, turn-around time and logistic support availability considerations, as well as system cost, weight, size and reliability constraints Applications are potentially more cost effective when designed, developed and operationally verified along with aircraft/engine developments rather than add-on or retrofit In this presentation, concepts are discussed based upon the results of completed research and development efforts that have demonstrated potential for diagnostic systems with application to these mission-oriented aircraft Expected benefits to be derived from such systems are also presented and these go beyond the often quoted go/no-go feature (Author)

A75-44211 Engine reliability with electronic controllers D M Newirth and H G Muller (United Aircraft Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn) In Annual Reliability and Maintainability Symposium, Washington, D C , January 28-30, 1975, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p 102-104

Electronic controllers have the potential of improving gas turbine engine reliability by precisely scheduling the established engine ratings, thereby eliminating certain overtemperature and overspeed conditions This results in reduced engine cyclic fatigue, a corresponding improvement in engine life, and a reduction in the number of required maintenance actions The electronic controller can also assist in maintenance trouble shooting procedures through fault identification and communication with other aircraft systems and ground support equipment The various aspects of electronic controller reliability are also explored (Author)

A75-44243 Helicopter failure modes and corrective actions J A Collins, B T Hagan (Ohio State University, Columbus, Ohio), and H M Bratt (U S. Army, Air Mobility Research and

Development Laboratory, Fort Eustis, Va) In Annual Reliability and Maintainability Symposium, Washington, D C , January 28 30, 1975, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 504-510 5 refs Grant No DAAJ02-73-C-0023 Army Task 1F162203A11907

Over two hundred forty case histories involving more than five hundred individual U S Army helicopter parts were categorized according to failure mode and corrective action employed Thirty-two different failure modes were identified in the study, with wear and wear-related failures accounting for over half of all failure problems The study indicates a need for better documentation of mechanical failure histories, including identification of the basic failure mode, engineering evaluation of the problem, corrective action proposed, when and how the corrective actions were implemented, and quantitative results of the corrective action in terms of failure statistics following implementation of the action The importance of separating mechanical failures by basic failure mode before attempting to analyze failures and corrective actions statistically is emphasized (Author)

A75-44249 Military aircraft maintenance - A new concept R A Barnard (Lockheed-California Co , Burbank, Calif) and T D Matteson (United Air Lines, Inc , San Francisco, Calif) In Annual Reliability and Maintainability Symposium, Washington, D C , January 28-30, 1975, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1975, p 596-600

A historical overview of military aircraft maintenance concept development is given, as well as a description of the new S-3 Viking maintenance plan More conservatism was built into the S-3 plan than into previous plans because (1) the airplane was new and (2) high leads would be imposed upon it by catapulting from and landing upon aircraft carriers Consequently, an eight phase maintenance cycle was substituted for the conventional four phase cycle, making the frequency of inspection twice as high as before S J M

A75-44348 Turbine engine parts life improvement through thrust management C O Spear (United Technologies Corp , Pratt and Whitney Aircraft Div , East Hartford, Conn) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750589* 9 p

The general subject of turbine engine thrust management includes the selection and setting of engine thrust Flight manual information available to the operator of turbine powered aircraft defines the methods for selecting thrust levels with relation to a predetermined minimum airplane performance standard The logical selection of thrust level to be used requires an understanding of the resultant effects on engine parts life as well as the effect on operating economics (Author)

A75-44349 Monitored thrust is a critical element in effective operations B Aubin (Air Canada, Montreal, Canada) *Society of Automotive Engineers, Air Transportation Meeting, Hartford, Conn , May 6-8, 1975, Paper 750590* 19 p

This paper is an attempt to establish the rationale for monitored, or reduced, thrust operations in Air Canada and their effect on safety, reliability, aircraft performance and economics It explains why an approach to operating at less than maximum takeoff thrust has been developed It demonstrates the effects of monitored thrust on power plants, operating temperatures, and training procedures Lastly, the paper explains how monitored thrust will produce an improvement in the environment and how it achieves an incremental saving in fuel (Author)

A75-44375 # Gas-turbine aircraft engines (Aviatsionnye gazoturbinnye dvigateli) M M Maslennikov and Iu I Shal'man Moscow, Izdatel'stvo Mashinostroenie, 1975 580 p 19 refs In Russian

The present work outlines the theory, design, and construction of gas-turbine aircraft engines and their most important components Engine operation and characteristics are discussed for turbojet, turboprop, and two-stage turbojet engines Theoretical foundations of fluid kinetic machines are presented Among the engine components examined are the axial-flow compressor, the centrifugal compressor, combustion chambers, and output devices Engine systems are analyzed as to lubrication, fuel feed, controls, and start-up S D

A75-44500 Double feedback loops stabilize landing-light servoactuators C A Belsterling (Franklin Institute, Philadelphia, Pa) and J Stone (U S Naval Air Engineering Center, Lakehurst, N J) *Hydraulics and Pneumatics,* vol 28, Sept 1975, p 101, 102

Two feedback loops under development to provide a stable shipboard mount for a new glide slope indicator (GSI) in an electrohydraulic servosystem are described The stabilized GSI projects a beam of light into the sky to guide helicopter pilots to a safe landing on a ship's deck The lighting system gives an image in the form of three horizontal bars, indicating the relative altitude of the aircraft There is an electronic control system that directs the operation of the hydraulic power supply, of which the feedback loops form a part S J M

A75-44529 Design of turbojet engines Panorama of technological problems (Conception des turboréacteurs - Panorama des problemes technologiques) M Gobin (SNECMA, Suresnes, Hauts-de-Seine, France) *Revue Française de Mécanique,* 4th Quarter, 1974, p 9 16 In French

The present work addresses the technological problems posed by the design of current turbojet engines, especially in the domain of cost effectiveness In order to improve profitability, three parameters must be maximized lightness, safety, and use economy Emphasis is on the use of intuition and common sense in the analysis of failures, as contrasted with the use of scientific approaches in the construction of functional structures Future improvements should concentrate on the use of new materials (oriented eutectics for turbine blades, powder metallurgy, composites) on the one hand, and the institution of new manufacturing procedures (friction-diffusion welding, chemical-electrochemical production) on the other The most spectacular improvements, however, will occur in the area of reliability and use economy, due to revolutionary means of monitoring, inspection, and in situ disassembly S J M

A75-44530 Determination of the lifetimes of gas turbine blades (Détermination des durees de vie des aubes de turbine a gaz) J -L Chaboche (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and C Stoltz (SNECMA, Suresnes, Hauts-de-Seine, France) *Revue Française de Mécanique,* 4th Quarter, 1974, p 37-47 23 refs In French

The principal stages in the design of gas turbine blades are briefly described in connection with associated mechanical, metallurgical, and thermal problems A method of cooling can be used which leads to an increase in thermal gradients, and the problem of determining lifetimes under thermal constraints can thus be considered at the design stage A recently developed procedure for predicting lifetimes is discussed and applied to convection-cooled turbine blades made from the refractory alloy IN 100 This method uses the laws of nonlinear viscoplastic behavior, a stepwise linearization with the hypothesis of flat sections, and the laws of fracture with a linear fatigue-creep interaction A series of cyclic loading tests on blades made of IN 100 confirms the validity of the prediction method S J M

A75-44551 Facets of the future fighter spectrum II E J Wootton *Interavia,* vol 30, Jan 1975, p 34-38

The need for a low-cost fighter is examined, taking into account the importance of a large force of aircraft for the basic fighter

mission of gaining and maintaining air superiority The pilots' viewpoint is considered and questions regarding the required aircraft complexity and capability are investigated Attention is given to the recognition of surface-to air missiles as a threat to air superiority, the air-combat-fighter project, the development of a minimum-cost radar system for aircraft, the significance of pilot experience, and Vietnam aerial combat experience G R

A75-44552 **General Dynamics' YF-16 - Design considerations and evolution** *Interavia,* vol 30, Jan 1975, p 39-41

A75-44553 **Rockwell International's B-1 bomber at a critical point** J P Geddes *Interavia,* vol 30, Feb 1975, p 132-138

In June 1970 contracts were awarded to American aerospace companies to build the B-1 bomber and its engines The B-1 contract called for five flight vehicles and one airframe for a full static test In January 1971, the program was cut back to three flight vehicles plus one structural airframe Department of Defense views of the B-1 are considered, taking into account the significance of the bomber within the 'Triad' concept of deterrence and the effects of changes in the contract related to the production decision Attention is given to the outsiders report concerning the adequacy of the development program, the problems of rising costs, the capabilities of the B-1, details of aircraft design, and the characteristics of the engine G R

A75-44555 **High performance and the F-15.** J P Geddes *Interavia,* vol 30, Feb 1975, p 190-195 5 refs

The F-15 Eagle air superiority fighter entered service with the U S Air Force Tactical Air Command in mid-November 1974 The capabilities of the aircraft are considered The Eagle is required to have the range and ability to penetrate a defensive electronic environment in any kind of weather to detect and identify targets, and then engage them with a wide variety of armaments A description of the Eagle airframe and engines is given and the major systems of the fighter are examined The integrated avionics for one-man operation are discussed along with the F-15 attack role, questions of maintainability, and procurement problems G R

A75-44556 **Keeping the rotors turning - Progress in the powerplant field** *Interavia,* vol 30, Mar 1975, p 252-254

It is pointed out that the lightweight helicopter market, the most numerous, is growing at up to 20 per cent annually, while the medium/heavy-lift spectrum is growing at around 12 per cent annually During the last few years, great strides have been made in the technology of engines for helicopters, all aimed at reducing operating and maintenance cost Developments in the powerplant field in various countires are examined, taking into account the U S , Canada, the Soviet Union, France, and the United Kingdom G R

A75-44557 **Helicopter electronics - A third of the cost in black boxes** D Boyle *Interavia,* vol 30, Mar 1975, p 263 267

Current and future projects and techniques in the field of helicopter electronics are considered, taking into account autostabili zation and automatic flight control systems, heading references, power supplies, the fly-by-light concept, en-route navigation, and the landing system MADGE MADGE (microwave aircraft digital guidance equipment) is designed to guide helicopters and fixed wing aircraft into confined landing areas in conditions of poor visibility, or at night En-route navigation can be carried out in a helicopter by the use of a wide variety of aids ranging from the basic VOR/ILS/DME and ADF to advanced inertial navigation systems G R

A75-44559 **Application of advanced test methods in engine development** *Interavia,* vol 30, Apr 1975, p 350 352, 354, 355, 357

Methods of determining operational characteristics, measuring power and efficiency, and testing function and reliability during the development of aircraft engines and their components are described Details on the stress testing of engine casings and compressor and turbine disks are given together with data on blade damage Engine test bed trials are discussed, and additional data for flight trials presented C K D

A75-44560 **Advances in engine manufacturing production techniques** R Scharwachter *Interavia,* vol 30, Apr 1975, p 358, 360

Major production techniques in joining, machining, and surface treatment of aircraft engines are described, and general guidelines are given for their use in the production of individual components Current welding procedures, cutting methods, electrochemical and electroerosion milling processes, and flame and plasma coating techniques are outlined C K D

A75-44561 **Powering the vertical-risers - Jet VTOL concepts reviewed** *Interavia,* vol 30, Apr 1975, p 375 377

The current status of VTOL power plant development is discussed with attention to both vectored-thrust and lift-cruise types Rolls Royce's 'plenum-chamber burning' system and Rockwell Inter national's Thrust Augmented Wing (TAW) are described, and a comparison of current VTOL programs is made Problems confronting future development are outlined C K D

A75-44564 **Boeing 747SP Shorter, faster, farther** *Interavia,* vol 30, July 1975, p 787-790

The systems, structural design, and performance of the Boeing 747SP are presented and compared with the earlier 747 versions The increased speed, lower weight, and greater range recommend the 747SP for longer routes, especially those in which air traffic is insufficient for a 747-200B, but above the capacity of a 707 The specifications of the aircraft are included and the modifications brought to the wing box, tail assembly, and cabin interior are discussed C K D

A75-44565 **Airbus industrie studying A 300 possibilities for further developments** *Interavia,* vol 30, July 1975, p 791-797

Short, medium, and long-term objectives of the A 300 development program are outlined, covering both military and civilian applications Proposed modifications of existing versions and the projected development of A 300 derivatives to fill gaps in the commercial aircraft spectrum are discussed, together with the specifications, operational data, and freight capacity of the various types of the aircraft C.K.D

A75-44566 **Aérospatiale's Dauphin - Profiting from Gazelle developments** *Interavia,* vol 30, Aug 1975, p 867-869

The Dauphin is the latest in the range of rotary-wing aircraft produced by a French aerospace company The first prototype of the SA 360, the single-turbine version of the Dauphin, flew for the first time in June 1972, while the second made its maiden flight in January 1973 It is expected that aircraft deliveries will begin in early-1976 Two twin-engined versions of the helicopter have also been built The Dauphin normally accommodates ten people The SA 360 revealed itself to be the fastest helicopter in the 3,000 kg class and established three world records in May 1973, including the demonstration of a speed of 299 km/hr over a 100 km circuit G R

A75-44567 **The Hughes YAH-64 AAH advanced attack helicopter** J P Geddes *Interavia,* vol 30, Sept 1975, p 972-975

Prototypes of an advanced attack helicopter (AAH) for the U S Army are being developed by two American aerospace companies The AAH is to replace the Bell AH-1G HueyCobra, the gunship used extensively in South-East Asia A large part of the AAH's firepower is the battery of TOW missiles intended to knock out tanks The gun on the helicopter is intended primarily for suppressive cover fire Differences in the design concepts provided by the two aerospace companies are discussed along with aspects of performance and

mission load Attention is also given to questions of survivability, maintainability, and testing The attack helicopter will rely on nap of the earth flying and maximum maneuverability to avoid enemy fire G R

A75-44673 **Materials technology** M Wilson and S Broadbent *Flight International,* vol 108, Sept 11, 1975, p 371-376

The main structural material for aeronautical applications remains aluminum alloy The utilization of fracture mechanics together with stress-corrosion studies has aided in the selection and the development of alloys with improved suitability characteristics The use of titanium in the aerospace industry is discussed and a description is given of the problems related to the development of suitable materials for a use in a modern jet engine Attention is also given to advances in the area of composites, taking into account cost factors, questions of manufacture, aspects of application, and some particular problems related to a use of composite materials G R

A75-44737 **Study of the fracture of thin plates made of light alloys used in the aeronautical domain (Etude de la rupture de plaques minces en alliages légers utilisés dans le domaine aéronautique)** C Bathias, M Gateau, J Philippe, and G Sertour (Societe Nationale Industrielle Aerospatiale, Suresnes, Hauts-de-Seine, France) *Revue de Métallurgie,* vol 72, July-Aug 1975, p 573 600 6 refs In French

Results of a study on the residual resistance and crack propagation speed during fatigue of three light alloys are presented Tests on flat specimens with a central notch show that the parameter Kc, the unstable fracture criterion, increases as the thickness of the sample decreases down to an optimal value of around 3 mm, below this thickness Kc diminishes The maximum toughness is observed when fracture occurs in shear Chemical composition and structure have specific influences on fatigue crack propagation speed in light alloys Sample thickness has a small effect on the crack speed Frequency and direction of propagation have no influence on the established cracking regime The fracture of a specimen under fatigue depends on the nominal constraint factor, which can be very different from the unstable fracture criterion S J M

A75-44818 **Acoustic radiation from an airfoil in a turbulent stream** R K Amiet (United Aircraft Research Laboratories, East Hartford, Conn) *Journal of Sound and Vibration,* vol 41, Aug 22, 1975, p 407-420 14 refs

A theoretical expression for the far-field acoustic power spectral density produced by an airfoil in a subsonic turbulent stream is given in terms of quantities characteristic of the turbulence For an observer directly above the airfoil the relevant quantities are the spanwise correlation length of the turbulence as a function of frequency and the PSD of the vertical velocity fluctuations In the derivation it is assumed that the spanwise correlation length is much smaller than the airfoil span A more solid theoretical foundation is developed for a lift expression given by Liepmann for an airfoil in turbulence Also, the analysis shows why it is not necessary, within certain limitations, to integrate over all gust wavenumbers in order to calculate the sound at a given observer location A comparison of the theory with experimental acoustic and lift measurements available in the literature shows good agreement (Author)

A75-44892 # **A few considerations on the trailing vortex appearing in the axisymmetric theory and the secondary flow theory** S Otsuka (Nagoya University, Nagoya, Japan) *Nagoya University, Faculty of Engineering, Memoirs,* vol 26, May 1974, p 124-140 12 refs

A study was undertaken to determine the connection between axisymmetric theory and secondary flow theory as applied to three-dimensional flow in turbomachinery It was found that both theories yielded the same equation for flow vorticity, but that the streamwise vorticity (trailing vortex) could not be obtained from this equation Rather, in axisymmetric theory, the trailing vortex strength was calculated from the flow condition just behind the blade array exit, and in secondary flow theory, the boundary condition of the Trefftz plane at the blade array exit determined the trailing vortex strength Results coincide for the limiting case of pitch tending to zero on a straight cascade S J M

A75-44893 # **On the potential theory of distributed singularities and its edge condition for a lifting flow of three-dimensional body** S Uchida and Y Nakamura (Nagoya University, Nagoya, Japan) *Nagoya University, Faculty of Engineering, Memoirs,* vol 26, Nov 1974, p 183-208 19 refs

The investigation is concerned with the determination of an edge condition which satisfies the Kutta condition, taking into consideration an approach in which the singular terms of self-induction that cause infinite velocities are eliminated The fundamental relations are explored, giving attention to the characteristics of distributed singularities, the equivalency theorem of doublet and vortex distributions, and the basic theory of an analysis of flow involving the consideration of distributed singularities Singularities of the induced velocity at the trailing edge are discussed along with the representation of Kutta's edge condition G R

A75-45014 **Electronic warfare - Military needs propel mini-RPVs into tactical flight tests** R T Davis *MicroWaves,* vol 14, Sept 1975, p 34-36, 38-41

Various new flight-tested mini-RPV prototypes are illustrated and explained They range from 45 to 150 pounds in weight with engines of 2-14 horsepower, and most contain a TV camera and laser relay beam for homing in on targets by large bombing aircraft Other possible payloads include radar jammers, simple decoys, and kamikazi warheads. The vehicles can be controlled directly from ground stations or through links with larger aircraft S J M

STAR ENTRIES

N75-29999 Calspan Corp , Buffalo N Y
IDENTIFICATION OF NONLINEAR AERODYNAMIC STABILITY AND CONTROL PARAMETERS AT HIGH ANGLE OF ATTACK
B J Eulrich and E G Rynaski *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 15 p refs

(Contract F33615-72-C-1248)

A procedure is described for the estimation of the nonlinear aerodynamic stability and control coefficients at high aircraft angles of attack It is based on a nonlinear iterated Kalman filter/fixed-point smoother identification algorithm and a least squares equation error method Key ingredients for successful identification are the mathematical model, instrumentation system control inputs and the identification algorithm The major emphasis is placed on the use of the identification procedure in analyzing high angle of attack flight data Specifically model form and initial estimates are established from wind tunnel data using series expansions to represent the nondimensional force and moment coefficients for selected ranges of angle of attack This high dimensional representation is reduced by (1) preprocessing the flight data using the instrumentation system model and the six-degree-of-freedom aircraft kinematic equations to perform optimal state estimation and hence decrease the effects of instrumentation errors, and (2) separating the six equations of motion into two separate four-degree-of-freedom systems, one for extracting the longitudinal coefficients and the other for the lateral-directional coefficients Specific problems associated with the identification procedure at high angles of attack and parameter identifiability problems caused by poorly conditioned flight data are reviewed Selection of the coordinate system for the aircraft model, the determination of the initial covariance estimates, and the measurement and process noise statistics required to use the iterated Kalman technique are discussed Author

N75-30000 Societe Nationale Industrielle Aerospatiale, Toulouse (France)
METHODS USED FOR OPTIMIZING THE SIMULATION OF CONCORDE SST USING FLIGHT TEST RESULTS
Jacques Tardy *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 10 p

The elaborate calculation means provided by a simulator were used in the design of CONCORDE Different simulators of more and more sophisticated design were installed from a fixed base analog simulator to the present simulator which is described This simulator is used for various design purposes development studies for the aircraft and its systems handling qualities flying controls, various piloting aids failure research flight test preparation and crew training crew work load studies, studies for introducing CONCORDE into air traffic in liaison with EUROCONTROL and preparation for aircraft certification, examination of requirements and participation in certification for the most critical conditions to be tested in flight testing very low probability failures or investigations in the extreme regulatory atmospheric conditions Author

N75-30001* National Aeronautics and Space Administration Langley Research Center Langley Station Va
APPLICATION OF A NEW CRITERION FOR MODELING SYSTEMS
Lawrence W Taylor, Jr *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 9 p refs

CSCL 12B

A new criterion is proposed for modeling systems which promises to be useful in deciding how complex a model should be The criterion is based on the expected model response error instead of the error in fitting the data used for estimating the model parameters The new criterion also does not require withholding data to be used exclusively for testing There remains, however the difficulty of testing a large number of candidate models that correspond to the combinations of terms used in the dynamic equations A computational approach is suggested which greatly reduces the computations required in searching for the best model In the suggested approach the gradient of the response with respect to the model coefficients is held fixed and numerous combinations of terms are assessed After determining the most promising candidate model, the gradient is updated and the process is repeated This procedure gives greater assurance that the best model is selected and does not rely on the analyst s judgement Author

N75-30005 Vereinigte Flugtechnische Werke-Fokker G m b H Bremen (West Germany)
SENSORS AND FILTERING TECHNIQUES FOR FLIGHT TESTING THE VAK 191 AND VFW 614 AIRCRAFT
Werner E Seibold *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 14 p

The flow of the flight test data of the VFW 614 (VAK 191B) Aircraft from the sensor through the data acquisition, selection and preprocessing process is described An overview of the sensors included in the VFW 614 is given Two important sensors for takeoff and landing performance are described The data smoothing and filtering techniques are discussed Special emphasis is given to a powerful digital filter, the Si or Riedel filter Author

N75-30006 National Aerospace Lab Amsterdam (Netherlands)
DESIGN AND EVALUATION OF A SYMMETRIC FLIGHT-TEST MANOEUVRE FOR THE ESTIMATION OF LONGITUDINAL PERFORMANCE AND STABILITY AND CONTROL CHARACTERISTICS
H W Kleingeld *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 6 p refs

Longitudinal performance and stability and control data are derived from measurements in one flight test maneuver The maneuver is comprised of quasi-steady accelerating parts and nonsteady oscillating parts A moving base simulator is used to determine the problems which accompany the manual application of the required elevator control input and to teach the pilot to generate the signal without feedback Results of this evaluation program are given and compared with corresponding results of the actual flight tests Author

N75-30007 Dornier-Werke G m b H Friedrichshafen (West Germany)
DETERMINATION OF STABILITY DERIVATIVES FROM FLIGHT TEST RESULTS COMPARISON OF FIVE ANALYTICAL TECHNIQUES
Horst Wuennenberg Heinz Friedrich Ulrich VonMeier and Hans-Joachim Munser *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 12 p refs

Analytical techniques in stability derivatives estimation are compared The test aircraft, a G 91-T3 was equipped with a sophisticated instrumentation and data acquisition system The analytical techniques manual evaluation of special flight maneuvers time vector method forced oscillation method analog matching and regression analysis are compared in relation to the amount of time and equipment for the flight testing, complication of the data reduction, and the quality of the results

The accuracy of the data acquisition is the most important problem Therefore an accurate check of all test data has to be performed before sophisticated evaluation programs are used It is summarized that several measuring and evaluation techniques should be used in parallel Author

N75-30008 Office National d Etudes et de Recherches Aerospatiales, Paris (France)
FIVE IDENTIFICATION METHODS APPLIED TO FLIGHT TEST DATA
Jean-Pierre Chaquin *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 8 p refs

The parameter of linear multivariable systems using input and output measurements is determined It is assumed that the physical system, which is to be investigated, can be described by a set of linear differential equations with constant coefficients These estimations are to be applied to the derivation of active control parameters Tests of well known methods, such as least squares modulating functions, conjugate gradients and analog matching, are developed Some results are proposed to be used as support for the comparison of the comparison of the different methods Author

N75-30009* Harvard Univ , Cambridge, Mass
STATUS OF INPUT DESIGN FOR AIRCRAFT PARAMETER IDENTIFICATION
R K Mehra and N K Eupta (Systems Control, Inc) *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 21 p refs
(Contracts NAS4-2068, N00014-67-A-0298-0006)
CSCL 01C

Results are presented on the design of aircraft inputs (i e elevator, rudder and aeleron deflection time histories) to identify aircraft stability and control derivatives from flight test data The problem is first reduced to an optimization problem with differential and integral constraints The criteria used are either expressed in terms of the Cramer-Rao lower bound on the covariance matrix of the parameter estimates or in terms of the maximum prediction error variance Both time-domain longitudinal and lateral dynamics of C-8 and Jet Star aircrafts and comparison with doublet type inputs are made Author

N75-30010 Calspan Corp , Buffalo N Y Flight Research Dept
INPUT DESIGN FOR AIRCRAFT PARAMETER IDENTIFICATION USING TIME-OPTIMAL CONTROL FORMULATION

Robert T N Chen *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 15 p refs

(Contract N00019-73-C-0504)

A new formulation and a practical and useful solution to the input design for identification of aircraft stability and control parameters is presented Necessary conditions and the structure of the optimal control input are discussed By using Walsh functions and calculating the Cramer-Rao lower bounds recursively, a practical and useful design procedure is then presented Application of the new approach are then made to the design of flight test inputs for identification of stability and control parameters of several types of aircraft Author

N75-30011 Royal Aircraft Establishment Farnborough (England)
DETERMINATION OF AERODYNAMIC DERIVATIVES FROM TRANSIENT RESPONSES IN MANOEUVRING FLIGHT

A Jean Ross *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 10 p refs

Computer programs using optimization techniques to obtain aerodynamic derivatives from flight records are briefly described Results pertaining to aircraft flying at high angles of attack are presented J M S

N75-30012 Naval Air Test Center Patuxent River Md Flight Test Div
ADVANCEMENT IN PARAMENTER IDENTIFICATION AND AIRCRAFT FLIGHT TESTING
Roger A Burton *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 16 p refs

Results are presented from a program to develop parameter identification technology with specific emphasis placed on studies conducted in parameter identifiability and (optimal) control inputs for parameter estimation Navy applications for parameter identification technology are discussed with specific areas in aircraft stability and control testing outlined Specific criteria required for defining optimal control inputs and establishing parameter identifiability are discussed Parameter identification results from the analysis of flight test data are presented which establish the need for considering input design in planning tests for extracting aerodynamic coefficients from flight test data Parameter identifiability results for specific control inputs used are presented In cases where identifiability problems are shown to exist the use of a rank deficient solution to improve parameter identifiability is demonstrated Author

N75-30013* National Aeronautics and Space Administration Flight Research Center, Edwards, Calif
PRACTICAL ASPECTS OF USING A MAXIMUM LIKELIHOOD ESTIMATOR
Kenneth W Iliff and Richard E Maine *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 15 p refs
CSCL 01C

The application of a maximum likelihood estimator to flight data is discussed and procedures to facilitate routine analysis of a large amount of flight data are proposed Flight data were used to demonstrate the proposed procedures Modeling considerations are discussed for the system to be identified, including linear aerodynamics, instrumentation, and data time shifts and aerodynamic biases for the specific types of maneuvers to be analyzed Data editing to eliminate common data acquisition problems and a method of identifying other problems are considered The need for careful selection of the maneuver or portions of the maneuver to be analyzed is pointed out Uncertaintly levels (analogous to Cramer-Rao bounds) are discussed as a way of recognizing significant new information Author

N75-30014 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Brunswick (West Germany) Inst fuer Flugmechanik
DETERMINATION OF AIRCRAFT DERIVATIVES BY AUTOMATIC PARAMETER ADJUSTMENT AND FREQUENCY RESPONSE METHODS
M Marchand and R Koehler *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 18 p refs

Experiences are reviewed in the estimation of aircraft parameters by means of three identification methods frequency response, maximum-likelihood and model with automatic parameter adjustment Results using flight test data from the Do-27 and HFB-320 aircraft are presented The effects of including nonlinear terms and turbulence in the model are also discussed The model with the automatic parameter adjustment method was used for studying the problems of derivative identification for rotorcraft type vehicles Preliminary results obtained when evaluating simulated Sikorsky S-61 flight data with various input signals are given Some aspects of designing input signals for flight tests are discussed system parameters and are easily flown by the pilot Author

N75-30015 Air Force Flight Test Center Edwards AFB, Calif
A COMPARISON AND EVALUATION OF TWO METHODS OF EXTRACTING STABILITY DERIVATIVES FROM FLIGHT TEST DATA
Paul W Kirsten *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 26 p refs

Two methods for extracting stability derivatives from flight data are compared A modified Newton-Raphson minimization technique and a digital-analog (hybrid) matching technique were used to analyze the same data maneuvers obtained from two aircraft About 55 maneuvers of an F-111E aircraft were analyzed over a Mach 0 3 to 2 0 and an angle of attack range of 3 to 19 degrees About 15 maneuvers were analyzed for the X-24A lifting body at Mach numbers of 0 8 and 0 9 and an angle of attack range of 4 to 13 degrees Stability derivatives were extracted from these maneuvers, and the results from the two techniques along with wind tunnel results were compared The hybrid matching mathematical model contained complete five-degree-of-freedom equations (no velocity derivatives) with variable dynamic pressure whereas the Newton-Raphson model used uncoupled, three-degree-of-freedom equations with constant dynamic pressure Both techniques were found to be capable of giving accurate results but required a fairly extensive knowledge of the method being used The Newton-Raphson technique tends to be less time consuming, and is suited for processing large quantities of data maneuvers Hybrid matching is well suited for programs in which a limited amount of data is processed for each flight Author

N75-30016 Technische Hogeschool Delft (Netherlands)
ESTIMATION OF THE AIRCRAFT STATE IN NON-STEADY FLIGHT
J A Mulder *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 21 p refs

Kalman filtering and smoothing and maximum likelihood estimation techniques were applied to the problem of estimating the aircraft state in nonsteady flight from onboard noisy inertial and barometric measurements Applied to actual flight test data, the estimation schemes yielded similar results Author

N75-30017 Dornier-Werke G m b H , Friedrichshafen (West Germany)
DETERMINATION OF STABILITY DERIVATIVES FROM FLIGHT TEST RESULTS BY MEANS OF THE REGRESSION ANALYSIS
Heniz Friedrich *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 8 p refs

Some fundamental remarks about regression analysis are made the method is described, and some test results with simulated data are given The experiences with regression analysis gained from flight tests with the aircrafts Dornier Do 31 and Fiat G91-T3 are discussed in detail The possibilities of the method were studied, and improvements by using a Kalman filter are considered For each equation of motion, an example is represented Author

N75-30018 Systems Control, Inc Palo Alto, Calif
MODEL STRUCTURE DETERMINATION AND PARAMETER IDENTIFICATION FOR NONLINEAR AERODYNAMIC FLIGHT REGIMES
W Earl Hall, Jr , Narendra K Gupta, and James S Tyler Jr *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 21 p refs
(Contract N00014-72-C-0328)

The identification of nonlinear stall/spin regime air dynamic forces and moments is discussed, along with applications to simulated and flight test response data For this development, a two-step method is presented The first step is the application of an algorithm which determines the order and coefficients of polynomial expansions which determines the order and coefficients of polynomial expansions which determines the order and coefficients of polynomial expansions of the nonlinear aerodynamic forces and moments which characterize the stall/post-stall flight regime The second step is the use of a nonlinear six degree-of freedom maximum likelihood algorithm which accurately estimates the values of the polynomial coefficients This method was applied to simulated and flight test data for a twin engine swept wing fighter aircraft Suggested approaches to general nonlinear flight regime identification are given Author

N75-30019* National Aeronautics and Space Administration Langley Research Center Langley Station, Va
IMPORTANCE OF HELICOPTER DYNAMICS TO THE MATHEMATICAL MODEL OF THE HELICOPTER
William F White Jr *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 12 p refs Prepared by Army Air Mobility Res and Develop Lab Hampton Va

CSCL 01C

A mathematical model of the helicopter requires appropriate representation of the constituent elements of rotor dynamics General-purpose programs that model a variety of configurations for a broad range of operating conditions result in varying and incompatible levels of sophistication Analysis of specific dynamic problems facilitates the identification of configuration parameters which determine system behavior For the present analysis, the nonlinear equations of a torsionally rigid hingeless rotor are linearized about an equilibrium condition to determine flap-lag stability characteristics in hover A collocation method was used to obtain the coupled natural frequencies and modes These modes allow exact treatment of the effect of elastic coupling which more than compensates for the destabilizing inertial coupling The sensitivity of damping to the number of modes was found to be small and reasonable accuracy was obtained the first flapwise and edgewise coupled modes The range of destabilizing precone was found to be small Author

N75-30020 National Aeronautical Establishment, Ottawa (Ontario) Flight Research Lab
ESTIMATES OF THE STABILITY DERIVATIVES OF A HELICOPTER AND A V/STOL AIRCRAFT FROM FLIGHT DATA
D G Grould and W S Hindson *In* AGARD Method for Aircraft State and Parameter Identification Jul 1957 9 p refs

Stability derivatives for the Bell 205 helicopter were derived from flight data using a least squares quasi-linearization technique The aircraft model, which included a first order representation of rotor response characteristics, was based on fundamental parameters descriptive of the particular design A conglomerate analysis procedure estimates based on data from several similar maneuvers was used to increase the confidence in the results observed Data from CL-84 V/STOL aircraft were also analyzed, indicating the validity of certain a priori longitudinal stability derivatives for the aircraft, and yielding estimates of others The results indicate the need to use a more elaborate modeling technique, (such as was used for the Bell 205) which takes into account the particular complexities of the aircraft Author

N75-30021* United Aircraft Corp , Stratford Conn Sikorsky Aircraft Div
ROTORCRAFT DERIVATIVE IDENTIFICATION FROM ANALYTICAL MODELS AND FLIGHT TEST DATA
John A Molusis *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 31 p refs Sponsored in part by NASA and USAAMRDL

CSCL 01C

A general procedure is presented for systematic development of rotorcraft models for use in systems identification, which includes fuselage and rotor degrees of freedom (DOF) Formulations for rigid blade flap and lag as well as the normal mode representation of an elastic blade are developed for hingeless and articulated rotor systems The method of multiblade coordinates is used to obtain linear constant coefficient state variable models of various levels of approximation Two of the approximate models a 6 DOF are identified from a nonlinear articulated helicopter computer simulation The results demonstrate the accuracy attainable for each model Advanced results outline the status of rotorcraft modeling and systems identification and indicate areas that require further investigation Author

N75-30022* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
ROTOR SYSTEMS RESEARCH AIRCRAFT (RSRA) REQUIREMENTS FOR, AND CONTRIBUTIONS TO, ROTORCRAFT STATE ESTIMATION AND PARAMETER IDENTIFICATION
Gregory W Condon *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 18 p refs Prepared by Army Air Mobility Res and Develop Lab, Hampton, Va

CSCL 01C

Rotor System Research Aircraft (RSRA) is designed to provide the capabilities necessary for the effective and efficient in-flight test and verification of promising rotor concepts and supporting technology developments The RSRA requirements for, and possible contributions to, rotorcraft state estimation and parameter identification technology are discussed Author

N75-30023 Bell Helicopter Co, Fort Worth, Tex
COMMENTS ON COMPUTATION OF AIRCRAFT FLIGHT CHARACTERISTICS
C L Livingston *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 8 p

A digital computer program (C81) used to compute performance, dynamics and loads of a wide variety of aircraft is described Some of the configurations which have been simulated on C81 are depicted Author

N75-30024 Calspan Corp, Buffalo N Y Flight Research Dept
THE EFFICIENT APPLICATION OF DIGITAL IDENTIFICATION TECHNIQUES TO FLIGHT DATA FROM A VARIABLE STABILITY V/STOL AIRCRAFT
J Victor Lebacqz *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 13 p refs

(Contracts N00019-69-C-0534 N00019-72-C-0044, N00019-72-C-0417, N00019-73-C-0504)

A prerequisite in the use of response-feedback variable stability aircraft to obtain flying qualities data is an accurate method for estimating stability and control parameters from flight data It is necessary, however, that such methods be efficient and cost effective to minimize the effort and expense spent performing the estimation The application of a digital identification technique X-22A V/STOL research aircraft is discussed Emphasis is placed on practical aspects of identifying efficiently data covering a wide range of dynamic characteristics, particular attention is paid to the elimination of adjustments in the technique for each data run and the use of particular pilot control inputs to maximize identifiability Results are presented for a variety of simulated dynamics Author

N75-30025* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
PARAMETER ESTIMATION OF POWERED-LIFT STOL AIRCRAFT CHARACTERISTICS INCLUDING TURBULENCE AND GROUND EFFECTS
Rodney C Wingrove *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 10 p refs

CSCL 01C

Longitudinal aerodynamic coefficients are estimated from data recorded during flight tests of a powered-lift STOL aircraft A comparison is made between the coefficient values determined by the regression and quasilinearization identification techniques from records taken during elevator pulse maneuvers The results show that for these tests the regression method provides less scatter in coefficient estimates and provides better correlation with the predicted values Special techniques are developed which allow identification of the coefficients from records taken during landing maneuvers in which the aircraft encounters turbulence while flying in ground effect Flight test results are presented to illustrate the effects of air turbulence and ground proximity on the estimated coefficient values Author

N75-30026 Air Force Flight Dynamics Lab, Wright-Pattarson AFB, Ohio
ESTIMATION OF ELASTIC AIRCRAFT AERODYNAMIC PARAMETERS
Robert C Schwanz and William R Wells *In* AGARD Methods for Aircraft State and Parameter Identification May 1975 10 p refs

The importance of including aeroelasticity in aircraft parameter estimation is discussed using the B52E and C-5A aircraft as examples A parameter estimation method, employing the modal truncation dynamics math model and the maximum likelihood estimation algorithm is selected to illustrate the computational difficulties that must be solved A combined in-house and contractual research program is then outlined that addresses these anticipated problem areas The aircraft selected for the initial application of the methods is the B52E that was flown in the Control Configured Vehicle (CCV) research program of the AF Flight Dynamics Laboratory Author

N75-30027# Advisory Group for Aeronautical Research and Development, Paris (France)
IMPACT OF ACTIVE CONTROL TECHNOLOGY ON AIRPLANE DESIGN
Jun 1975 318 p refs In ENGLISH and partly in FRENCH Presented at a Joint Symp of the Flight Mech Panel and Guidance and Control Panel of AGARD Paris, 14-17 Oct 1974 (AGARD-CP-157) Avail NTIS HC $9 25

The papers are reported which were presented at sessions on active control technology in advanced airplane design, analysis and simulation programs flight test programs advanced flight control systems, and current operational systems They cover a wide range of activities from advanced research to systems in operation on the C-5A and Boeing 747 aircraft

N75-30028 Societe Nationale Industrielle Aerospatiale Toulouse (France)
CCV PHILOSOPHY SEMANTICS AND UNCERTAINITY THE CONCEPT OF AIRCRAFT REVOLUTION BY PROGRESS IN THE FLIGHT CONTROL SYSTEM [CCV PHILOSOPHIE SEMANTIQUE ET INCERTITUDES LA CONCEPTION DES AVIONS VA-T-ELLE ETRE BOULEVERSEE PAR LES PROGRES DANS LES SYSTEMES DE COMMANDES DE VOL]
P Lecomte and M Bossard *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 14 p refs In FRENCH, ENGLISH summary

The possible definitions are examined of the term control configured vehicle (CCV) and some other associated notions such a autostabilization, flight by wire etc The characteristics common to all the so called CCV systems are examined simultaneously together with the most noteworthy differences encountered The present possibilities of these systems are reviewed considering, for each case, the safety objectives, and performance objectives for transport and combat aircraft Finally long term prospects are considered Author

N75-30029 Royal Aircraft Establishment, Bedford (England)
ACTIVE CONTROL AS AN INTEGRAL TOOL IN ADVANCED AIRCRAFT DESIGN
W J G Pinsker *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 12 p refs

The scope of active control in the design and operation of aircraft is broadly reviewed and the automatic control stability and control augmentation, artificial static stability gust alleviation, stall and spin protection and various methods for reducing airframe loads are studied It is argued that active control should not be treated as a piece-meal solution to isolated design problems but rather refinements will the true potential of these powerful techniques be realized In particular it is shown that many CCV applications require commensurate improvement in the aerodynamic performance of the control surface Author

N75-30030* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
POTENTIAL BENEFITS TO SHORT-HAUL TRANSPORTS THROUGH USE OF ACTIVE CONTROLS
D William Conner and Glenn O Thompson (Boeing Co , Wichita Kans) *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 10 p refs

The potential applications of active controls are examined for improving the characteristics of transport type aircraft used in short-haul service (< 1 000-kilometer range capability) The types of aircraft to meet future needs (quiet operation, congestion alleviation, fuel conservation, operating economy, and traveler acceptance) are identified as helicopters for shorter stage lengths and fixed wing aircraft of reduced field-length capability for longer stage lengths Likely uses for active controls for these aircraft are examined regarding payoffs which can be expected and problems and constraints which must be dealt with Uses showing significant benefits include augmented stability and control, gust-load alleviation and ride smoothing Gust-load alleviation is particularly effective for low-wing-loading aircraft employing conventional lift Ride-smoothing systems are indicated to be the furthest advanced and ready for production commitment for those applications where they can be shown to have payoff
Author

N75-30031 Messerschmitt-Boelkow-Blohm G m b H Hamburg (West Germany)
TRANSPORT AIRCRAFT WITH RELAXED/NEGATIVE LONGITUDINAL STABILITY RESULTS OF A DESIGN STUDY
Heinz G Klug *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 15 p

Application of active longitudinal control on transport aircraft with relaxed/negative longitudinal stability was studied Using two aircraft of different configuration as baseline designs versions incorporating active longitudinal control were derived Configuration changes were studied with varying tail size and center of gravity position Based upon the requirement for handling qualities equivalent to the baseline designs, optimum control laws were derived Controllability and stability were checked by simulating various gust cases Limits for tail size and cg-position were derived Wing size was changed where required to hold performance unchanged Structural and fuel weight changes were calculated and the configuration, within the geometrical and controllability limits giving the highest payload increase was selected Sensitivity of payload benefit to performance specification was checked by parametric variations It was found that payload benefit depends upon configuration to a high degree Best payload benefit will be achieved for high wing T-tail STOL aircraft using large trailing edge flaps Payload increase may be up to 15% for such aircraft
Author

N75-30032 British Aircraft Corp , Weybridge (England) Commercial Aircraft Div
IMPACT OF ACTIVE CONTROL TECHNOLOGY ON AIRCRAFT DESIGN
P R G Williams and B S Campion *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 6 p

Use of active control technology on civil transport aircraft is considered both as regards improvement of a conventional aircraft and as regards development of new configurations to exploit such technology Significant gains in weight and operating cost may be made by using artificial stability augmentation and load alleviation on a conventional design, though the precise gains depend on the way in which weight savings are exploited Unconventional means are suggested whereby active control technology might best be exploited on short and long range subsonic aircraft, and also on supersonic aircraft It appears that the largest gains are likely to be made when new techniques are used in combination rather than singly
Author

N75-30033 Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
HORIZONTAL CANARDS FOR TWO-AXIS CCV FIGHTER CONTROL
S C Stumpfl and R A Whitmoyer *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 8 p

The potential use is described of active horizontal canards in the design of fighter aircraft to provide flight path control along both the longitudinal and directional axes The results are based on wind tunnel tests conducted on two CCV fighter configurations under the Fighter CCV Program of the USAF Flight Dynamics laboratory A method for generating direct sideforce using differentially deflected horizontal canards is discussed The direct lift control capabilities of horizontal canards are also presented In addition, the use of horizontal canards in implementing the concepts of relaxed static stability and maneuver polar enhancement is described Finally the USAF Fighter CCV Program is outlined as it relates to demonstrating the performance improvements achievable through application of advanced control system technology
Author

N75-30034 Hawker Siddeley Aviation Ltd Brough (England)
ACTIVE CONTROL TECHNOLOGY A MILITARY AIRCRAFT DESIGNER'S VIEWPOINT
R Melling *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 16 p

The most likely gains to be obtained by the application of active control technology to small combat aircraft are considered There are seen to be considerable attractions although the most significant benefits may turn out to be orientated towards the improved control and design freedom offered by ACT rather than towards revolutionary shapes or greatly increased efficiency or reduced weight In the design of the ACS itself, it is considered essential that a mechanical back up is avoided in order to produce a more flexible, efficient and safe system and to this end a suitably progressive system design philosophy must be developed Despite some doubts as to the more ambitious claims for ACT, its ultimate adoption is expected for all but the simplest of aircraft
Author

N75-30035 National Aerospace Lab , Amsterdam (Netherlands)
HANDLING QUALITY CRITERIA DEVELOPMENT FOR TRANSPORT AIRCRAFT WITH FLY-BY-WIRE PRIMARY FLIGHT CONTROL SYSTEMS
H A Mooij *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 14 p refs

The introduction of fly-by-wire primary flight control systems in future transport aircraft, in some cases including direct-lift-control, makes it highly desirable to initiate further studies into handling quality criteria for future guidance in system design The handling quality criteria for such aircraft must be based on parameters which describe the combination of the aircraft and its closed-loop flight control system Approach flight simulation and compensatory tracking, performed on a three degrees of freedom flight simulator as applied to a conceptual jet transport developed around the relaxed static stability concept, is described The stiffness of the pitch attitude system and the effectiveness of the direct-lift-control-system were varied The following topics are discussed required direct-lift-control-effectiveness for an aircraft with a very low value of the normal acceleration sensitivity required bandwidth of the pitch attitude control system for an aircraft with a value of the normal acceleration sensitivity typical for the present-day jumbo aircraft pilot opinion on the absence of a stable stick force/(deflection) versus airspeed gradient for pitch-stabilized aircraft results of compensatory tracking experiments and evaluation of the applicability of the criterion for the configurations tested
Author

N75-30036 Messerschmitt-Boelkow-Blohm G m b H , Munich (West Germany)
CONTROL OF AN ELASTIC AIRCRAFT USING OPTIMAL CONTROL LAWS
Werner Dressler *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 11 p

The design of a multivariable control system for gust alleviation is demonstrated The use of computers for control design summarized under the name computer aided design is described The gust control system for gust alleviation is integrated into an overall flight guidance control system Two control designs, using optimal control laws are achieved one with complete and the second with incomplete state measurement In the model description the elastic behavior of the wing is included as well as the nonsteady aerodynamic lift generation and the dynamic behavior of the actuators For a STOL-transport aircraft the efficiency of gust alleviation are shown in a flight through turbulent air The increase of wing lifetime and the corresponding decrease in structure weight by use of a gust alleviation system is calculated Author

N75-30037 Office National d Etudes et de Recherches Aerospatiales Paris (France)
CLOSED FORM EXPRESSION OF THE OPTIMAL CONTROL OF A RIGID AIRPLANE TO TURBULENCE
Gabriel Coupry *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 10 p refs In FRENCH, ENGLISH summary

The flight of military aircraft at high speed, low altitude makes it necessary to use ride control systems to improve comfort, handling qualities and combat ability The open loop system that is described senses turbulence which is used, after filtering to act on the controls Such a system does not change at all the handling qualities of the aircraft Wiener's theory is used to to derive in closed form the transfer function of the filter used for control It is shown that this transfer function can be expressed in autoadaptative form, the poles being proportional to the velocity of the aircraft The influence of parameters like mass, scale of turbulence, is discussed Author

N75-30038 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Dynamik der Flugsysteme
APPLICATION OF ADVANCED MODEL-FOLLOWING TECHNIQUES TO THE DESIGN OF FLIGHT CONTROL SYSTEMS FOR CONTROL CONFIGURED VEHICLES
Gerd Hirzinger *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 15 p refs

After a review of optimal control the model-following concept is applied for approaching a desired tracking behavior especially concerning the airplane s response to a flight path angle command in a systematic way However it turns out that the disturbance behavior of the controlled system, represented by the airplane's response to an initial deviation in the flight path angle is unsatisfactory Therefore a new concept combining model-following and partial state-vector feedback is applied for designing disturbance behavior and tracking behavior separately in each of both cases achieving a good compromise between the desired system trajectory and limited control action It appears that the control system thus designed is very insensitive to variations in the most critical parameter that is the location of the center of gravity Author

N75-30039 McDonnell Aircraft Co , St Louis Mo
SURVIVABLE FLIGHT CONTROL SYSTEM ACTIVE CONTROL DEVELOPMENT, FLIGHT TEST, AND APPLICATION
F M Krachmalnick R L Berger (AFFDL) J E Hunter J W Morris (AFFDL) and J K Ramage (AFFDL) *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 24 p

The major portion of the Survivable Flight Control System (SFCS) Program initiated by the United States Air Force in July 1969 was performed to establish the practicality of active control concepts for use in future military aircraft The SFCS quadruplex (four channel redundancy) primary flight control system is described Incorporation of this type of control system in a tactical vehicle is expected to provide benefits in enhanced survivability reliability, maintainability cost of ownership aircraft design freedom, and aircraft maneuvering performance The simulations and ground-based system compatibility testing performed to verify equipment performance and establish high level of pilot confidence prior to flight are discussed A summary of the flight test results obtained during 84 successful flights is presented Flight test results indicate that the F-4 with the SFCS installed exhibits greatly improved handling qualities over those characteristic of the production F-4 This aircraft incorporating control configured vehicle and maneuver load control conceptual features was successfully test-flown and evaluated Results obtained from the pilot-in-the-loop simulations and actual flight tests are discussed Flight test results verify that significant performance improvements in combat maneuvering envelope buffet levels and specific excess power are achievable in the F-4 with judicious application of control configured vehicle concepts Author

N75-30040 Air Force Armament Lab Eglin AFB Fla
WEAPON DELIVERY IMPACT ON ACTIVE CONTROL TECHNOLOGY
H Smith and Dave Carleton (AFFDL) *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1971 14 p refs

The need for cooperative efforts among the laboratories/test-organizations and users is emphasized to improve and properly match aircraft pointing and armament component accuracies to achieve the maximum effectiveness with conventional weapons The Data Measurement Programs of the Armament Development and Test Center/Air Force Armament Laboratory are discussed, including the results and plans for the Instrumented Rack/Bomb and Gunnery Pipper/Fireline Trace and Impact Pattern Model Programs The Active Control Technology Programs of the Air Force Flight Dynamics Laboratory including objectives, designs, and results of the Tactical Weapon Delivery (TWeaD) Program are discussed The objectives of the Multimode Control and the Control Configured Vehicle/Advanced Fighter Technology Integrator Programs are delineated It is concluded that incorporation of active control technology and matched armament component accuracies in future weapon systems shows promise for considerable improvement in the effectiveness of unguided weapons Author

N75-30041 Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
CONTROL CONFIGURED VEHICLES B 52 PROGRAM RESULTS
Bruce T Kujawski *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 8 p refs

The concepts considered for the CCV B-52 program, and the expected benefits are discussed The system design criteria are described along with the maneuver load control system An off design condition is evaluated F O S

N75-30042 Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
A QUADREDUNDANT DIGITAL FLIGHT CONTROL SYSTEM FOR CCV APPLICATION
Wolfgang J Kubbat *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 9 p

A parallel redundant digital fly-by-wire system is described It will be tested in the near future on a CCV-test aircraft (modified F-104 G) Starting from a fail-op, the reasons for the choice of a digital system are outlined The system works with freely programmable identical airborne computers which run identical software The computers perform the control laws and act also as central voters and monitors Basic of the design is the principle of majority decision with elimination of a failed component Finally the Quadruplex system represents a functional integration of autopilot, stabilization, air data computation and built-in-test-equipment Author

N75-30043 Naval Air Development Center Warminster, Pa
THE ASSET (ADVANCED SKEWED SENSORY ELECTRONIC TRIAD) PROGRAM

C R Abrams and W D Weinstein (Grumman Aerospace Corp) *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 12 p refs

A redundant arrangement of angular rate sensors with skewed input axes dispersed on an aircraft bulkhead, was designed for fly-by-wire control applications Compared to other redundant configurations, it best satisfied system reliability, survivability, and maintenance requirements By also utilizing a high reliability solid-state angular rate sensor expected maintenance costs will be decreased The data management system designed for the ASSET configuration featured a parallel path failure detection and isolation algorithm A unique method of selecting failure thresholds was developed to insure that false alarm probability and system errors were minimized The results of this effort will contribute to the practical implementation of a digital fly-by-wire system, since a successful attempt was made to match proposed operational requirements The ASSET concept will therefore provide a fail-operational and combat-survivable set of rate sensors designed to interface with all active control systems regardless of redundancy requirements Author

N75-30044 Marconi-Elliott Avionic Systems Ltd , Rochester (England) Flight Control Div

THE RELEVANCE OF EXISTING AUTOMATIC FLIGHT CONTROL SYSTEMS TO THE FUTURE DEVELOPMENT OF ACTIVE CONTROL **c08**

R Ruggles, D Sweeting, and I A Watson *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 15 p refs (For availability see N75-30027 21-01)

Some relevant examples of failure-survival automatic flight control systems are examined to show how the results of their design, implementation and operational usage can contribute to the successful introduction into full-time use of active control technology (ACT) Ground rules which were evolved some years ago for such redundant systems are re-examined in the interest of full-time ACT The important parameters affecting the successful design of a full-time ACT system are discussed Some of the problem areas are mentioned and the use of some existing techniques for successful certification are suggested The step from current fail-operative systems relying on some reversionary system to full-time ACT is examined The design requirements for the hardware and software for digital computations are detailed and some special problems of digital systems are highlighted and solutions are suggested Some of the problems of system components such as sensors, computers and actuators are discussed Author

N75-30045 Sperry Rand Corp , Phoenix, Ariz Sperry Flight Systems

PRODUCTION DESIGN REQUIREMENTS FOR FLY BY WIRE SYSTEMS

J Flannigan and J Emfinger *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 11 p refs

The problems of specifying design requirements for production Fly-By-Wire (FBW) flight control systems are addressed based on current state-of-the-art trends The design goals and requirements of two development FBW programs are reviewed Emphasis is placed on the impact of specific requirements on hardware mechanization complexity Of particular interest is the sensitivity of FBW system design to safety, survivability and mission reliability requirements and to related subsystem and interface concepts Experience to date is used to provide recommendations and insight into specifying practical design requirements for production FBW systems Author

N75-30046 British Aircraft Corp (Operating) Ltd Bristol (England) Avionics Engineering Dept

EXPERIENCE WITH THE CONCORDE FLYING CONTROL SYSTEM

Neville Brenchley and Ronald Grant *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 14 p

The Concorde Flight Control System is discussed along with its performance reliability and behavior in flight Possible future developments are considered Author

N75-30047 Societe Nationale Industrielle Aerospatiale Toulouse (France)

DESIGN OF AN ENTIRELY ELECTRICAL FLYING CONTROL SYSTEM

G Broihanne R Deque, and M Bossard *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 13 p

After reviewing the reasons for using entirely electrical flying controls that is controls without mechanical standby systems, and defining the control modes available for a transport aircraft, the general architecture of the system is described It is shown that if safety requirements impose minimum redundancy, several precautions must be taken for the theoretical reliability achieved by this redundancy to be real The equipment required is described briefly From a maintenance point of view, the complexity of the system is compared with that of the flying controls on existing aircraft Author

N75-30048 Royal Aircraft Establishment Farnborough (England) Flight Systems Dept

THE HUNTER FLY-BY-WIRE EXPERIMENT RECENT EXPERIENCE AND FUTURE IMPLICATIONS

F R Gill and P W J Fullham *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 12 p refs

The impact of active control technology on the design of future aircraft depends on the development of full-time and full authority control systems which have an integrity similar to that of the basic airframe One of the major items of the R and D Programme in the UK which is aimed at providing this flight experience with this system is described The implications of the future application of active control technology are discussed in terms of the airworthiness problem and the manner of designing systems so as to ease the certification of high integrity full-time and full authority control Author

N75-30049* National Aeronautics and Space Administration Flight Research Center, Edwards Calif

F-8 DIGITAL FLY-BY-WIRE FLIGHT TEST RESULTS VIEWED FROM AN ACTIVE CONTROLS PERSPECTIVE

Kenneth J Zalai and Dwain A Deets *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 14 p refs

The results of the NASA F-8 digital fly-by-wire flight test program are presented, along with the implications for active controls applications The closed loop performance of the digital control system agreed well with the sampled-data system design predictions The digital fly-by-wire mechanization also met pilot flying qualities requirements The advantages of mechanizing the control laws in software became apparent during the flight program and were realized without sacrificing overall system reliability This required strict software management The F-8 flight test results are shown to be encouraging in light of the requirements that must be met by control systems for flight-critical active controls applications Author

N75-30050 Boeing Commercial Airplane Co , Seattle Wash

USE OF ACTIVE CONTROL TECHNOLOGY TO IMPROVE RIDE QUALITIES OF LARGE TRANSPORT AIRCRAFT

Gerald C Cohen and Richard L Schoenman *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1975 16 p refs

The analyses, construction and flight testing of two systems, Beta-vane and modal suppression augmentation system (MSAS), which were developed to suppress gust induced lateral accelerations of large aircraft are described The Boeing 747 transport was used as the test vehicle The purpose of the Beta-vane system is to reduce acceleration levels at the dutch roll frequency whereas the function of the MSAS system is to reduce accelerations due to flexible body motions caused by turbulence

Data from flight test, with both systems engaged, shows a 50-70 percent reduction in lateral aft body acceleration levels It is suggested that present day techniques used for developing dynamic equations of motion in the flexible mode region are limited These techniques produce results which are satisfactory for analyzing dynamic loads and stability problems, but may be insufficient for development of active control systems operating in the same frequency region Author

N75-30051 Lockheed-Georgia Co , Marietta
THE C-5A ACTIVE LIFT DISTRIBUTION CONTROL SYSTEM
William F Grosser Wayne W Hollenbeck, and Don C Eckholdt *In* AGARD Impact of Active Control Technol on Airplane Design Jun 1971 18 p refs

The technical details are presented of the development of the Active Lift Distribution Control System (ALDCS) for the C-5A aircraft A structural loads, and flutter-control system interaction are developed in such a way that the unique aspects of the analysis, aeroelastic wind tunnel test, and flight test portion are bound together to indicate the system design characteristics performance The purpose of the ALDCS is to reduce gust and maneuver incremental wing root bending moments while minimizing the effects of the control system on torsion flutter, and flying qualities These criteria are based on axial load reduction as a means of improving wing fatigue endurance without significantly affecting existing flutter margins or handling qualities Even though this is a retrofit system which was required to use as much existing hardware as possible, throughout the flight test all design goals were met The system is currently planned to be manufactured and installed on the fleet during the next several years Author

N75-30052# Advisory Group for Aerospace Research and Development, Paris (France)
THE GUIDANCE AND CONTROL OF V/STOL AIRCRAFT AND HELICOPTERS AT NIGHT AND IN POOR VISIBILITY
May 1975 281 p refs In ENGLISH and partly in FRENCH Presented at the 18th meeting of the Guidance and Control Panel of AGARD, Stuttgart, 14-16 May 1974
(AGARD-CP-148) Avail NTIS HC $8 75

Reports are presented concerning (1) requirements, tasks, and environments, (2) performance and design of low light, infrared and other sensors, (3) man/machine interface, (4) navigation and guidance, and (5) implications on flight control and autopilot design

N75-30053 Ministry of Defence, Bonn (West Germany)
THE USE OF HELICOPTER CAPABILITIES IN BAD WEATHER NEEDS AND REQUIREMENTS FOR FUTURE EQUIPMENT
K W Ernst *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 8 p

The operational requirements and problems for improving the use of helicopters in bad weather conditions are discussed The characteristics for the wide spectrum of applications are given along with flight profiles for bad weather F O S

N75-30055 Army Combat Developments Experimentation Command, Fort Ord, Calif
EFFECT ON NAP-OF-THE-EARTH REQUIREMENTS ON AIRCREW PERFORMANCE DURING NIGHT ATTACK HELICOPTER OPERATIONS
In AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 10 p refs

Night nap-of-the-earth (NOE) flight is described as it relates to three major areas man, machine and operational use The findings and operational experience reported were encountered in exploratory efforts for a major field experiment Activities discussed include aviator selection and training, psychological and physiological effects, mission planning, map reading and terrain interpretation aircraft handling emergency procedures and man-machine operations Behavioral research requirements and other needs established for night NOE training and operations by current scout and attack helicopters are presented, and a training program for night NOE training is offered as a general guideline Author

N75-30056 United Aircraft Corp Stratford Conn Sikorsky Aircraft Div
H-53 NIGHT OPERATIONS
Richard L Mills *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 8 p refs

The H-53 Night Operation System (NOS) includes night vision equipment and an approach and hover coupler The automatic approach and hover coupler subsystem permits the pilot to transition automatically over all types of terrain, including mountains, from search altitude and cruise speed to a hover and automatically maintain the hover The night vision equipment extends this capability to night flights The basic system was declared operational by the United States Air Force following a ninety-day combat evaluation in Southeast Asia It is also used by foreign military Extensive flight testing and operational use have led to additional development tests to further the capabilities of NOS Flight test results of a prototype symbology generator and prototype electronic location finder hover coupler are discussed along with the night vision equipment and the approach and hover coupler Author

N75-30057 Human Engineering Labs , Aberdeen Proving Ground, Md
US ARMY EXPERIENCE IN LOW-LEVEL NIGHT FLIGHT

Robert W Bauer *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 6 p refs

During the period of U S conflict in Southeast Asia there were a number of air operations conducted under adverse visibility conditions or at night There were even a few night operations involving large numbers of aircraft but most were made up of one or two aircraft, engaged in an insertion, extraction long-range patrol or supply movement Some lessons learned from these experiences are reviewed Current developments and testing have demonstrated an improved capability in night flight, using either selected specialists without night vision systems or a wider group of aviators aided by the night vision goggles The electroluminescent formation flight lights and rotor-tip lights have greatly increased safety in formation flights at night But each approach has been hampered by design limitations in display panels poor lighting quality and poor lighting control in the aircrew stations Landing in dark unimproved areas, navigation over unfamiliar terrain and target acquisition also present special problems which have not yet been completely overcome Author

N75-30058 Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany)
REQUIREMENTS FOR OPERATION OF LIGHT HELICOPTERS AT NIGHT AND IN POOR VISIBILITY
M Rade *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 12 p refs

Normally the VTOL-ability of helicopters is not used under Instrument Flight Rules For helicopter missions at night and in poor visibility special devices are necessary but there are only some experimental systems partly derived from devices for fixed wing aircraft Basic requirements for normal missions will be defined They include handling qualities navigation equipment and landing aids The use of sensors giving high definition pictures of the terrain in nonvisual conditions are considered Secondary requirements are generated by some problems resulting from the full use of the all weather capability They consist of the concept of automatic flight-control-systems and display-arrangements for the pilot These additional requirements depend on the planned missions and on the possibilities, which are given by the type of helicopter As important conditions for special missions deicing noise reduction, infrared and radar camouflage will be discussed Author

N75-30059 Royal Aircraft Establishment, Farnborough (England)
HELICOPTER AVIONICS UK RESEARCH PROGRAMME

H B Johnson *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 7 p refs

A limited review of the status of UK avionic systems for helicopters is given and the current needs of military helicopters discussed The rapidity with which the use of helicopters has grown is such that it is no longer possible to meet these needs by simple modification of off the shelf equipment A program of research and development work specifically directed towards the needs of helicopters is outlined This program is centered around the use of a Sea King Mk I helicopter and is aimed at equipping this vehicle with a number of new equipments in the areas of flight control, electronic displays and computer aided navigation Particular emphasis is placed on the development of night vision systems for use in helicopters and an experimental pilot's TV system is described This will be used to explore fundamental aspects of imaging systems prior to the use of an LLTV camera for typical night flying tasks Author

N75-30060 Naval Weapons Center, China Lake, Calif
MICROWAVE RADIOMETRIC ALL-WEATHER IMAGING AND PILOTING TECHNIQUES
Robert P Moore *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 10 p

The Naval Weapons Center (NWC), China Lake Calif U S A has developed a millimeter-wave radiometer capable of producing high-quality images Automatic terrain correlation aircraft navigation was demonstrated using real-time in-flight digital processing For V/STOL aircraft and helicopter applications during hover and descent a system capable of rapid two-dimensional scanning will be the most useful It is indicated that automatic navigation can be carried out with a very economical nonscanning device Author

N75-30061 Royal Aircraft Establishment, Farnborough (England) Instrumentation and Ranges Dept
APPLICATIONS OF LOW LIGHT TELEVISION TO HELICOPTER OPERATIONS
R J Corps *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 2 p

The status of LLTV systems in the UK is reviewed With the aid of cine film practical results which have been obtained with several systems from helicopters during recent years are presented Author

N75-30062 Army Electronics Command Fort Monmouth, N J Avionics Lab
AN OPTICAL RADAR SYSTEM FOR OBSTACLE AVOIDANCE AND TERRAIN FOLLOWING
C M Kellington *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 6 p refs

The operational requirements are discussed for obstacle avoidance and terrain following systems, the nature of obstacles, the tradeoff considerations involved in the selection of a laser for a system and finally a unique state of the art carbon dioxide (CO_2 - 10 6 micron) laser radar system presently under development Atmospheric penetration properties of the 10 micron radiation which permit moderate weather operation are deduced The main thrust centers around a technical description of the CO_2 system which is called the Laser Obstacle/Terrain Avoidance Warning System (LOTAWS) System parameters e g 30 KHz pulse rate, 10 watts average power, 1/3 milliradian beamwidth 300 nanosecond pulse width 20 deg x 20 deg field of view etc , and the methods by which they are achieved are discussed Other system characteristics including the local oscillator, IF bandwidth, AFC loops, scanner and scan patterns, signal processing, and display to the pilot are discussed Finally plans for integration of the LOTAWS with other airborne equipment, including forward looking IR sensors and flight tests beginning in 1974 are outlined Author

N75-30063 Royal Radar Establishment Malvern (England) Airborne Radar Group
IR THERMAL IMAGING SENSORS FOR HELICOPTERS

F A Holmes *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 4 p

The general requirements are considered for night vision sensors which can assist the helicopter crew in their flying and tactical tasks during night operations It is shown that two classes of sensors are needed, one for the pilot to fly the helicopter and the other for surveillance and target acquisition The performance parameters required for each class of sensor are analyzed and some of the constraints and compromises on the sensor design are considered The parameters thus derived show that a common sensor is not compatible for both the flying and target acquisition functions Some of the vehicle integration and systems interface aspects are discussed to indicate that the final cost-effective choice is most likely to be determined from the overall system considerations rather than that of the IR sensor Display requirements for both functions are shown to lead to larger units than are currently considered possible for cockpit installation and matching of the sensor, display and operator performances are likely to be the main problem in future systems Author

N75-30064 Army Night Vision Lab , Fort Belvoir Va
NIGHT VISION IMAGING SYSTEM DEVELOPMENT FOR LOW LEVEL HELICOPTER PILOTAGE
Karl Stich *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 5 p

Flight test data of low level night operations in UH-1 helicopters using electro-optical image forming sensors as a pilot flight aid are presented, along with details of the systems used in the investigations Significant findings and major problem areas driving future work are given along with some present night vision pilot aids Finally, long range night vision developments for helicopter pilotage are examined Author

N75-30065 Army Electronics Command, Fort Monmouth, N J Avionics Lab
LOW LEVEL NIGHT OPERATIONS OF TACTICAL HELICOPTERS
William J Kenneally *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 14 p refs

Initial results are presented of the U S Army s Low Level Night Operations Program, an on-going research program to define Avionic equipment parameters for low level night and adverse weather conditions Results of the program include quantitative data on the performance of pilots flying at low level with varying levels of avionic equipment augmentation (e g none, Night Vision Goggles, FLIR, LLLTV and Radar), simulation and experimental flight test data on conceptual systems (e g symbolically augmented visual imaging systems) as well as experimental measurements of various candidate hardware for obstacle detection The results are utilized to develop preliminary conceptual avionic systems for low level night operations as well as to identify areas in which additional research is required Future research efforts directed to identified barrier problems are also presented Author

N75-30068 Royal Aircraft Establishment, Farnborough (England) Avionics Dept
THE FLIGHT DEVELOPMENT OF ELECTRONIC DISPLAYS FOR V/STOL APPROACH GUIDANCE
J N Barrett and R G White *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 16 p refs

Two series of flight trials are described which were aimed at the development of electronic displays for the approach guidance of V/STOL aircraft in visual and IFR conditions The first series of trials was flown in the Canadair CL84 and was aimed at extending the approach capability of current operational

V/STOL aircraft The second, flown in the Shorts SC1 investigated the terminal guidance of inter-city VTOL transport aircraft Performances achieved in the two trials are discussed and display and flight control system changes are recommended Author

N75-30069 Royal Aircraft Establishment, Farnborough (England) Experimental Flying Dept
PILOTING ASPECTS OF V/STOL APPROACH GUIDANCE

C C Rustin *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 9 p refs

A pilot s viewpoint is presented of the results of the handling display and operational aspects encountered during the flight trials of the CL-84 and SC-1 aircraft Author

N75-30070 Bell Helicopter Co , Fort Worth Tex
RESEARCH ON DISPLAYS FOR V/STOL LOW-LEVEL AND IMC OPERATIONS
Dora Dougherty Strother and Hubert W Upton *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 11 p refs

The results of several research studies covering cockpit displays and their effect on the performance of helicopter pilots These studies evaluated displays used for the guidance and control of helicopters at night and in restricted visibility especially for operations at extremely low altitudes Author

N75-30073 Office National d Etudes et de Recherches Aerospatiales, Paris (France)
A GUIDANCE SYSTEM FOR FIXED OR ROTARY WING AIRCRAFT IN APPROACH AND LANDING ZONES
Jean Besson *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 8 p refs In FRENCH, ENGLISH summary

The proposed system for guiding fixed or rotary wing aircraft in approach and landing zones makes use of the time-frequency principle It ensures all weather guidance over a few kilometers or, in a more sophisticated form, the ground control of aircraft in approach It is based on the measurements of the distance separating the moving vehicle from a number of ground stations Its main advantages are the use of independent measurements, time multiplexing avoiding frequency cluttering, and the possibility of entering into a multifunction integrated system Author

N75-30074 VDO-Luftfahrtgeraete Werk Adolf Schindling G m b H , Frankfurt (West Germany)
THE NUCLEAR LANDING AID FOR HELICOPTERS DURING THE FINAL APPROACH PHASE
Karl H Busch *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 13 p

A method and procedure are described for landing a helicopter in poor visibility on a beam generated by two gamma-ray sources The one source gives the pilot the distance on the flightpath to go and to land safely in front of the source the other gives pitch- and bank-commands indicated with a cross-pointer-instrument The aim was to get a light weight, unsophisticated device with simple ground equipment for which batteries and power generators can be omitted The prototype-equipment on board the helicopter consists of three gamma-ray detectors and one electronic box to drive the instruments, while the ground equipment consists of one shielding case with both the sources and collimators inside The center line of the beams can be adjusted to different pitch angles by turning the case around the horizontal axis Author

N75-30075 MEL Equipment Co Ltd , Crawley (England)
DEVELOPMENTS IN THE MADGE LANDING AID
D Atter *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 7 p refs

Microwave aircraft digital guidance equipment (MADGE) is a portable approach and landing aid suited to tactical operations involving helicopters, V/STOL or fixed-wing aircraft operating into secondary airfields and confined landing sites The equipment is capable of providing the equivalent of civil category-II performance when deployed at runway threshold or on a helicopter pad Rapid deployment is possible by two men and the equipment can be operational within 15 minutes of arrival at the landing site Up-dated information is provided on the development status of the equipment, some aspects are described of exploitation of the system's flexibility afforded by the integral two-way selectively addressed data link in conjunction with the wide-angle coverage and availability of aircraft coordinates both in the air and on the ground Author

N75-30077 Boeing Vertol Co , Philadelphia, Pa
HEAVY-LIFT HELICOPTER FLIGHT CONTROL SYSTEM DESIGN
E D Diamond and J M Davis *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 10 p

The Army heavy-lift helicopter (HLH) is designed to operate under instrument flying conditions Dynamic performance, reliability, and survivability considerations, led to selection of a fly-by-wire flight control system with no mechanical backup Present helicopter handling qualities are generally not acceptable to fly with heavy external loads (up to 35 tons in the HLH case) into unprepared areas under instrument conditions This mission required development of new helicopter handling qualities including automatic precision hover hold, linear velocity control responses load stabilization and automatic approach to hover Efficient hover and low-speed operations necessitated incorporation of a rear-facing station for a load controlling crewman who has separate aircraft controls optimized for the precise maneuvering and trim-hold functions required for cargo transfer Development of the HLH primary and automatic flight control systems is discussed Pertinent flight simulation and hardware ground- and flight-test results are reported Author

N75-30078 Royal Aircraft Establishment, Farnborough (England)
HELICOPTER AUTOMATIC FLIGHT CONTROL SYSTEMS FOR POOR VISIBILITY OPERATIONS
P Robinson, J L Hollington (Smiths Industries Ltd), and J Meadows (Smiths Industries Ltd) *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 13 p refs

Operations are described which helicopters may be required to carry out at night and in poor visibility Because of the very high pilot work load likely to arise in these situations, it is shown that the helicopter should be equipped with an autostabilization system having a defect-survival capability One system which meets this requirement was developed for installation and trails in a Sea King helicopter This system is triplex with digital computation and has the development potential to include autopilot facilities sophisticated control techniques, and extended system redundancy The redundancy philosophy together with salient design and engineering details of the system are described Author

N75-30079 Sperry Rand Corp Phoenix Ariz
AN AUTOMATIC FLIGHT CONTROL SYSTEM FOR A HELICOPTER NIGHT LANDING SYSTEM
R J Miller and E R Tribken *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 9 p refs

An automatic flight control system (AFCS) is described which provides the vehicle with handling qualities sufficient for the pilot to perform IFR approach and landings manually using cockpit displays It provides absolute maximum operational simplicity so as not to contribute to cockpit workload already increased by the requirement to operate display controls The AFCS provides stability and command augmentation in pitch, roll and yaw, and the pilot relief functions of pitch, roll, heading hold, and both

barometric and radar altitude hold To provide the improved handling qualities required for the night landing problem feedback gains and shaping were chosen to attenuate basic aircraft response and to provide model following of the closed-loop system The rationale behind the specific aircraft response provided by the system for this mission, the establishment of the operational characteristics and procedures, and the implementation of the system are described in detail Author

N75-30080 Societe de Fabrication d' Instruments de Mesure SFIM Massy (France)
LOW VISIBILITY APPROACH OF HELICOPTERS AND ADAC AIRCRAFT [L'APPROCHE SANS VISIBILITIE DES HELICOPTERES ET DES AVIONS ADAC. CONSIDERATIONS SUR LE DEVELOPPEMENT ET RESULTATS OPERATIONNELS]
J C Grisard *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 22 p In FRENCH

The development of prolonged helicopter flight capability without visibility was examined Automatic pilots and stabilization equipment were studied as possible methods of developing such flight The SFIM principle was used to develop a family of automatic pilots for utilization in SA 330, SA 321, and the Alouette 3 VSV series helicopters Operational results covering flight approach, control, and direction are given

Transl by E H W

N75-30081 Naval Air Test Center, Patuxent River, Md Flight Test Div
US NAVY VTOL AUTOMATIC LANDING SYSTEM DEVELOPMENT PROGRAM
Robert S Buffum, Richard W Huff and Gerald L Keyser *In* AGARD The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility May 1975 8 p

The role of fixed and rotary wing VTOL in military missions was expanded with the advent of the light airborne multipurpose system and the sea control ship concepts A project is described to coordinate the various technologies which impact on the capability of the pilot, the aircraft system and the landing environment, with a goal of an approach hover, and landing under instrument meteorological conditions A number of display and automatic control system development programs which will be of significance in the VTOL hover and landing are discussed Hovering vehicle versatile automatic control is a research and development automatic flight control system which was utilized to develop the requirements for VTOL automatic approach, hover, and landing The test program to date includes system definition of the vehicle dynamics via a sine wave forcing function method Curved and straight path approaches were controlled by the airborne digital computer in a simulated microwave landing system environment Author

N75-30091 Stuttgart Univ (West Germany) Inst fuer Aerodynamik und Gasdynamik
INFLUENCE ON THE TIME OF VARIOUS CLIMBING METHODS BEYOND THE KAISER TURN
H Stuemke *In* DGLR Contrib to Fluid Mech and Flight Mech 25 Jul 1974 15 p refs In GERMAN, ENGLISH summary

For the climbing flight beyond the singular arc, Kaiser proposes subarcs with constant energy altitude Subarcs with a maximal climbing or gliding angle were investigated which are still compatible with the assumption of quasistationarity The climbing times related to these three methods are compared for small deviations of the initial or end state from the Kaiser turn The climbing method turns out to be the most favorable

Author (ESRO)

N75-30092 Stuttgart Univ (West Germany) Inst fuer Aerodynamik und Gasdynamik
THE WEDGE ANGLE OF LAMINAR SEPARATION BUBBLES
F X Wortmann *In* DGLR Contrib to Fluid Mech and Flight Mech 25 Jul 1974 13 p refs In GERMAN ENGLISH summary Sponsored by Deut Forschungsgemeinschaft

The different behavior of separation bubbles and the mechanism of bubble bursting is described The role of the transition process is pointed out It is shown that the wedge angle between the surface and the separating streamline has a strong influence on the transition An empirical relationship for the size of the wedge angle is given Author (ESRO)

N75-30094+ Engineering Sciences Data Unit London (England)
WAVE DRAG OF WINGS AT ZERO LIFT IN INVISCID AIRFLOW
May 1975 17 p ref Supersedes Aero-W S 02 03 01 Sponsored by Roy Aeron Soc
(ESDU-75004) Copyright Avail NTIS HC $122 50

Data on wave drag of wings at zero lift are provided for use in estimating missile drag The data are applicable to wings with symmetrical double-wedge or parabolic-arc sections for all taper ratios, 0 2c equal to or less than 0 6c beta A equal to or less than 7, A tan Lambda sub 1/2 equal to or less than 6 inviscid supersonic airflow, and zero lift Author

N75-30095+ Engineering Sciences Data Unit London (England)
PERFORMANCE DATA FOR THE CRITICAL OPERATION OF NOMINALLY TWO-DIMENSIONAL DOUBLE-RAMP SUPERSONIC INTAKES
Jun 1975 40 p refs Sponsored by Roy Aeron Soc
(ESDU-75005) Copyright Avail NTIS HC $290 50

Data on the performance of nominally two-dimensional double-ramp supersonic intakes are provided for use in initial estimation of performance of supersonic aircraft engine air intakes The data are applicable for intake design Mach numbers from 2 0 to 2 8, for first ramp inclination of 6 to 12 deg for free stream Mach numbers from 1 6 to design value in inviscid flow Author

N75-30096+ Engineering Sciences Data Unit, London (England)
FREQUENCIES OF VERTICAL AND LATERAL LOAD FACTORS RESULTING FROM GROUND MANOEUVRES OF AIRCRAFT
Jul 1975 11 p refs Sponsored by Roy Aeron Soc
(ESDU-75008) Avail NTIS HC $74 50

Data on the magnitude and frequency of occurrence of vertical and lateral load factors resulting from ground maneuvers of fixed wing aircraft are provided for estimating loads on aircraft undercarriages structure etc occurring during ground operations The data are applicable to all types of fixed wing aircraft operating from paved runways and taxiways during all phases of ground operations Author

N75-30097+ Engineering Sciences Data Unit, London (England)
INFORMATION ON THE USE OF DATA ITEMS ON FLAPS INCLUDING ESTIMATION OF THE EFFECT OF FUSELAGE INTERFERENCE
Jul 1975 7 p refs Supersedes Aero-F 00 01 00 Sponsored by Roy Aeron Soc
(ESDU-75013) Copyright Avail NTIS HC $36 00

The use of the flap series, which deals with changes in lift pitching moment and drag of a wing due to the deflection of trailing edge flaps is reviewed for slotted, plain and split type flaps The lift coefficient increment pitching moment coefficient increment drag coefficient increment at zero lift are analyzed along with lift-dependent drag Means for estimating the fuselage interference effects due to deflection of trailing-edge flap on a wing in isolation are also presented F O S

N75-30099*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
APPROXIMATE METHOD FOR CALCULATING TRANSONIC FLOW ABOUT LIFTING WING-BODY CONFIGURATIONS COMPUTER PROGRAM AND USER'S MANUAL
Richard W Barnwell and Ruby M Davis Aug 1975 135 p refs
(NASA-TM-X-72758) Avail NTIS HC $3 75 CSCL 01A

A user's manual is presented for a computer program which calculates inviscid flow about lifting configurations in the free-stream Mach-number range from zero to low supersonic Angles of attack of the order of the configuration thickness-length ratio and less can be calculated An approximate formulation was used which accounts for shock waves, leading-edge separation and wind-tunnel wall effects Author

N75-30100*# Texas A&M Univ , College Station
TRANSONIC AIRFOIL FLOWFIELD ANALYSIS USING CARTESIAN COORDINATES Final Report
Leland A Carlson Washington NASA Aug 1975 33 p refs (Grant NGR-44-001-157)
(NASA-CR-2577) Avail NTIS HC $3 75 CSCL 01A

A numerical technique for analyzing transonic airfoils is presented The method employs the basic features of Jameson's iterative solution for the full potential equation, except that Cartesian coordinates are used rather than a grid which fits the airfoil such as the conformal circle-plane or 'sheared parabolic' coordinates which were used previously Comparison with previous results shows that it is not necessary to match the computational grid to the airfoil surface, and that accurate results can be obtained with a Cartesian grid for lifting supercritical airfoils Author

N75-30101*# National Aeronautics and Space Administration Ames Research Center Moffett Field, Calif
SIMPLIFIED LIFTING-SURFACE THEORY FOR FLAPS ON WINGS OF LOW AND MODERATE ASPECT RATIOS
Bradford H Wick Washington Sep 1975 9 p refs
(NASA-TN-D-8060, A-6108) Avail NTIS HC $3 25 CSCL 01A

A modification of the simplified lifting-surface theory for wings with deflected flaps is presented and evaluated The modification is simple and straightforward in application, and is shown to overcome the deficiency in the theory that results in an underestimation of flap lift effectiveness for wings that have low or moderate aspect ratios Author

N75-30103*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
EFFECTS OF SPANWISE BLOWING ON THE PRESSURE FIELD AND VORTEX-LIFT CHARACTERISTICS OF A 44 DEG SWEPT TRAPEZOIDAL WING
James F Campbell Washington Jun 1975 141 p refs
(NASA-TN-D-7907 L-10047) Avail NTIS HC $5 75 CSCL 01A

Wind-tunnel data were obtained at a free-stream Mach number of 0 26 for a range of model angle of attack jet thrust coefficient and jet location Results of this study show that the sectional effects to spanwise blowing are strongly dependent on angle of attack, jet thrust coefficient and span location the largest effects occur at the highest angles of attack and thrust coefficients and on the inboard portion of the wing Full vortex lift was achieved at the inboard span station with a small blowing rate but successively higher blowing rates were necessary to achieve full vortex lift at increased span distances It is shown that spanwise blowing increases lift throughout the angle-of-attack range delays wing stall to higher angles of attack and improves the induced-drag polars The leading-edge suction analogy can be used to estimate the section and total lifts resulting from spanwise blowing Author

N75-30104*# Boeing Commercial Airplane Co Seattle, Wash
PREDICTION OF UNSTEADY AERODYNAMIC LOADINGS CAUSED BY LEADING EDGE AND TRAILING EDGE CONTROL SURFACE MOTIONS IN SUBSONIC COMPRESSIBLE FLOW ANALYSIS AND RESULTS Final Report
W S Rowe M C Redman, F E Ehlers and J D Sebastian Washington NASA Aug 1975 154 p refs
(Contract NAS1-12020)
(NASA-CR-2543) Avail NTIS HC $6 25 CSCL 01A

A theoretical analysis and computer program was developed for the prediction of unsteady lifting surface loadings caused by motions of leading edge and trailing edge control surfaces having sealed gaps The final form of the downwash integral equation was formulated by isolating the singularities from the nonsingular terms and using a preferred solution process to remove and evaluate the downwash discontinuities in a systematic manner Comparisons of theoretical and experimental pressure data are made for several control surface configurations The comparisons indicate that reasonably accurate theoretical pressure distributions and generalized forces may be obtained for a wide variety of control surface configurations Spanwise symmetry or antisymmetry of motion and up to six control surfaces on each half span can be accommodated Author

N75-30105*# Purdue Univ Lafayette Ind School of Mechanical Engineering
THEORY OF AN AIRFOIL EQUIPPED WITH A JET FLAP UNDER LOW-SPEED FLIGHT CONDITIONS Final Report
F L Addessio and J G Skifstad Washington NASA Jul 1975 141 p refs
(Grant NGL-15-005-094)
(NASA-CR-2571) Avail NTIS HC $5 75 CSCL 01A

A theory is developed, for the inviscid, incompressible flow past a thin airfoil equipped with a thin part-span jet flap, by treating the induced flowfields of the jet and the wing separately and by obtaining the fully coupled solution in an iterative manner Spanwise variation of the jet vortex strength is assumed to be elliptical in the analysis Since the method considers the vorticity associated with the jet to be positioned on the computed locus of the jet the downwash aft of the wing is evaluated as well as forces and moments on the wing A lifting-surface theory is incorporated for the aerodynamics of the wing Computational results are presented for a rectangular wing at momentum coefficients above 2 0 and compared with existing linear theories and experimental data Good agreement is found for small angles of attack jet-deflection angles and jet-momentum coefficients where the linear theories and experimental data are applicable Downwash data at a point in the vicinity of a control surface the load distribution on the airfoil and the jet and the jet location are also presented for representative flight conditons Author

N75-30106# Advisory Group for Aerospace Research and Development, Paris (France)
VORTEX WAKES OF CONVENTIONAL AIRCRAFT
Coleman duP Donaldson (Aeron, Res Assoc of Princeton Inc N J) Alan J Bilanin (Aeron Res Assoc of Princeton Inc, N J) and R H Korkegi, ed (ARL) May 1975 85 p refs (AGARD-AG-204) Avail NTIS HC $4 75

The present state of knowledge of vortex wakes of conventional aircraft is presented Topics discussed include roll-up of trailed vorticity, aircraft wake geometry sinusoidal instability and vortex breakdown, aging of vortices persistance of vortices in the atmosphere and aircraft design techniques to minimize wake hazard Author

N75-30107*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LOW SPEED WIND TUNNEL INVESTIGATION OF A LARGE-SCALE ADVANCED ARROW WING SUPERSONIC TRANSPORT CONFIGURATION WITH ENGINES MOUNTED ABOVE THE WING FOR UPPER-SURFACE BLOWING
An Early Domestic Dissemination Report
James P Shivers H Clyde McLemore and Paul L Coe Jr Aug 1975 69 p refs
(NASA-TM-X-72761) Avail NASA Industrial Application Centers only to U S Requestors HC $4 25/MF $2 25 CSCL 01A

Tests were conducted in the Langley full scale tunnel to determine the low speed aerodynamic characteristics of a large scale advanced arrow-wing supersonic transport configuration with engines mounted above the wing for upper surface blowing Configuration variables included trailing edge flap deflection, engine jet nozzle angle engine thrust coefficient engine out operation, and asymmetrical trailing edge BLC for providing roll trim Downwash measurements at the tail were obtained for different thrust coefficients tail heights and at two fuselage stations Author

N75-30108*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FLOW VISUALIZATION OF LEADING-EDGE VORTEX

ENHANCEMENT BY SPANWISE BLOWING
Gary E Erickson (George Washington Univ) and James F Campbell Sep 1975 108 p refs
(NASA-TM-X-72702) Avail NTIS HC $5 25 CSCL 01A

Flow visualization studies were conducted in a small pilot wind tunnel to determine qualitative effects of blowing a discrete jet essentially parallel to the leading edge of a 45 deg-swept trapezoidal wing featuring leading- and trailing-edge flaps Test parameters included wing angle-of-attack, jet momentum coefficient leading- and trailing-edge flap deflections and nozzle chordwise displacement Results of this study indicate that blowing from a reflection plane over the wing enhances the leading-edge vortex and delays vortex bursting to higher angles-of-attack and greater span distances Increased blowing rates decrease vortex size, growth rate and vertical displacement above the wing surface at a given span station and also extend the spanwise effectiveness of lateral blowing Deflection of a leading-edge flap delays the beneficial effects of spanwise blowing to higher angles-of-attack Nozzle chordwise locations investigated for the wing with and without leading-edge flap deflection appear equally effective in enhancing the separated leading-edge flow Author

N75-30109*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FREE-FLIGHT MODEL INVESTIGATION OF A VERTICAL-ATTITUDE VTOL FIGHTER
William A Newsom Jr and Ernie L Anglin Washington Sep 1975 34 p refs Technical film supplement L-1186 available on request
(NASA-TN-D-8054, L-10345) Avail NTIS HC $3 75 CSCL 01C

Tests were made in the Langley full-scale tunnel and included a study of the stability and control characteristics of delta- and swept-wing configurations from hovering through the transition to normal forward flight Static force tests were also conducted to aid in the analysis of the flight tests With conventional artificial rate stabilization very smooth transitions could be made consistently with relatively little difficulty Because of the lower apparent damping and a tendency to diverge in yaw, however, the swept-wing configuration was considered to be much more difficult to fly than the delta-wing configuration With rate dampers off both configurations were very difficult to control and the control power needed for satisfactory flights was substantially higher than with the rate dampers operating Author

N75-30111*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
A STOL AIRWORTHINESS INVESTIGATION USING A SIMULATION OF AN AUGMENTOR WING TRANSPORT VOLUME 1 SUMMARY OF RESULTS AND AIRWORTHINESS IMPLICATIONS Final Report
Robert L Stapleford (Systems Technol Inc, Mountain View, Calif), Robert K Heffley (Systems Technol, Inc Mountain View, Calif), Charles S Hynes and Barry C Scott (FAA, Moffett Field Calif) Oct 1974 55 p refs Sponsored in part by FAA
(Contract NAS2-7926)
(NASA-TM-X-62395, AD-A005878 FAA-RD-74-179-Vol-1 A-5797-Vol-1) Avail NTIS HC $4 25 CSCL 01A

A simulator study of STOL airworthiness criteria was conducted using a model of an augmentor wing transport The approach flare and landing, go-around and takeoff phases of flight were investigated The results are summarized and possible implications with regard to airworthiness criteria are discussed The results provide a data base for future STOL airworthiness requirements and a preliminary indication of potential problem areas The results are also compared to the results from an earlier simulation of the Breguet 941S Where possible airworthiness criteria are proposed for consideration Author

N75-30112# Deutsche Gesellschaft fuer Luft- und Raumfahrt Cologne (West Germany)
FORCE MEASUREMENTS ON PARTS OF WIND TUNNEL MODELS
1975 198 p refs In GERMAN, ENGLISH summary Proc of the Meeting of the DGLR Sci Comm 3 4 on Flow Mech Testing Tech Bremen, 5 Jun 1973
(DLR-Mitt-75-02) Avail NTIS HC $7 00, DFVLR, Cologne DM 69 80

The problem of aerodynamic force measurements was dealt with Multicomponent strain gaps were used in determining these forces The measurement of wing and tailplane loads on a semimodel of the European Airbus A 300 B was reported Interference effects of a slender wing-body configuration were experimentally determined Hinge moments, rudder and fin loads of a horizontal tail surface with a rudder were examined The tail drag of an aircraft was determined in a transonic wind tunnel Aerodynamic interference forces were analyzed by splitting up a model in several parts Tail assemblies of missiles were investigated

N75-30113 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Zentralabteilung Niedergeschwindigkeits-Windkanaele
MEASUREMENT OF WING AND TAILPLANE LOADS ON THE MODEL OF THE EUROPEAN AIRBUS A 300 B [MESSUNG DER FLUEGEL- UND LEITWERKSLASTEN AM HALBMODELL DES EUROPAEISCHEN AIRBUS A 300 B]
W Baumert and R Wulf *In* DGLR Force Meas on Parts of Wind Tunnel Models 1975 p 7-21 refs In GERMAN

Strain gage balance force measurements on model parts carried out in low speed wind tunnels at Braunschweig and Goettingen are reported The test set-up and measuring equipment for a semimodel of the European Airbus A 300 B is detailed Pressure distribution and force measurements were carried out for the wing and tailplane of this model under simultaneous jet simulation ESRO

N75-30114 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Inst fuer Stroemungsmechanik
EXPERIMENTAL DETERMINATION OF INTERFERENCE EFFECTS OF A SLENDER WING-BODY CONFIGURATION [EXPERIMENTELLE BESTIMMUNG VON INTERFERENZEFFEKTEN AN EINER SCHLANKEN FLUEGEL-RUMPF-ANORDNUNG]
W Schneider *In* DGLR Force Meas on Parts of Wind Tunnel Models 1975 p 25-36 refs In GERMAN

The determination of wing-body interference by strain gage measurement of partial loads is illustrated for a slender body Present technology allows the construction of wind tunnel balances of small dimensions which enable the determination of partial forces parallel to the global force measurements of wind tunnel models ESRO

N75-30115 Vereinigte Flugtechnische Werke-Fokker G m b H, Bremen (West Germany)
MEASUREMENT OF HINGE MOMENTS, RUDDER AND FIN LOADS OF A HORIZONTAL TAIL SURFACE, WITH ONE- AND SIX-COMPONENT STRAIN GAGE BALANCES [MESSUNG VON SCHARNIERMOMENTEN, RUDER- UND FLOSSENLASTEN AN EINEM HOEHENLEITWERK MIT EIN- UND SECHSKOMPONENTEN-DMS-WAAGEN]
J Krahl *In* DGLR Force Meas on Parts of Wind Tunnel Models 1975 p 37-77 refs In GERMAN

The application of internal strain gage balances to a tail semimodel to determine the partial loads and moments of a horizontal tail surface with a rudder is described The construction of the model the design and placing of the balance the automatic data acquisition and evaluation, as well as some selected results, are briefly described ESRO

N75-30116 Messerschmitt-Boelkow-Blohm G m b H Ottobrunn (West Germany)
DETERMINATION OF AIRCRAFT TAIL DRAG IN THE TRANSONIC WIND TUNNEL FOR SEVERAL TAIL AND NOZZLE SHAPES AND A SIMULATED COLD ENGINE JET [BESTIMMUNG DES FLUGZEUG-HECKWIDERSTANDES IM

TS-WINDKANAL MIT VERSCHIEDENEN HECKUND DUESENFORMEN BEI SIMULIERTEM KALTEN TRIEBWERKSSTRAHL]
H Braun *In* DGLR Force Meas on Parts of Wind Tunnel Models 1975 p 79-91 In GERMAN

A test stand for experimentally determining jet aircraft tail drag in a transonic wind tunnel is described The setup allows interchanging the jet nozzles and provides compressed air for jet exhaust simulation ESRO

N75-30117 Vereinigte Flugtechnische Werke-Fokker G m b H Bremen (West Germany)
DETERMINATION OF AERODYNAMIC INTERFERENCE FORCES USING THE VFW-FOKKER PARTIAL-LOAD METHOD [ERMITTLUNG VON AERODYNAMISCHEN INTERFERENZKRAEFTEN MIT DER VFW-FOKKER-TEILLASTENMETHODE]
B Ewald *In* DGLR Force Meas on Parts of Wind Tunnel Models 1975 p 93-110 In GERMAN

A partial load method was developed for investigation of interference effects in which the body of the wind tunnel model is split up into separate parts and the aerodynamic forces acting on each part are separately measured The advantages of this method are the external contour of the model consists of a simple shell without any measuring equipment, the model interior (central support with balance) can be used for several aircraft geometries, and the results of measurements supply direct information about aerodynamic force distribution and interference behavior ESRO

N75-30125# Texas A&M Univ , College Station
AERODYNAMIC THEORY FOR A CASCADE OF OSCILLATING AIRFOILS IN COMPRESSIBLE SUBSONIC FLOW Interim Report, 1 Jul - 31 Dec 1974
W P Jones and Jimmie A Moore Feb 1975 36 p refs
(Grant AF-AFOSR-2700-74, AF Proj 9781)
(AD-A008890, TEES-3068-75-01 AFOSR-75-0475TR) Avail NTIS CSCL 20/4

A simple numerical technique is developed for determining the airload coefficients on a typical airfoil of the cascade The effects of varying airfoil spacing, frequency Mach number and phase difference between adjacent blades are investigated In particular the variations in the aerodynamic damping for pure vertical translational and pitching motions are considered It is shown that translational damping can become zero but never negative at certain discrete frequencies Furthermore the results indicate that the pitching moment aerodynamic damping referred to the quarter-chord axis while also being zero at the critical frequencies can be negative at the higher Mach numbers over a wide range of frequencies of interest in flutter analysis The effects of varying the stagger angle of the cascade are not considered in the present paper GRA

N75-30126# Hydronautics Inc Laurel Md
THE PRESSURE FIELD OF A VORTEX WAKE IN GROUND EFFECT
Clinton E Brown 1975 9 p refs
(Contract F44620-71-C-0080 AF Proj 9781)
(AD-A008857, AFOSR-75-0495TR) Avail NTIS CSCL 01/1

The ground pressures under a descending pair of vortices such as might be generated by aircraft either landing or taking off are computed It is found that as the vortices first approach the ground, only positive pressures are produced, however as the descent continues the high velocity field of the vortices makes itself apparent in dips to sub-atmospheric pressure which lie closely beneath the vortex center Nevertheless, a substantial positive pressure hill precedes the path of the vortex as it moves laterally in the ground effect The level of pressures produced is dependent only on the flight speed, lift coefficient and aspect ratio while the length scale of the pressure distribution is proportional to the span These results may be useful in the development of systems to monitor multiple aircraft take-off and/or landing operations GRA

N75-30128# Army Missile Research Development and Engineering Lab , Redstone Arsenal Ala
ROTOR DOWNWASH VELOCITIES ABOUT THE UH-1M HELICOPTER FLIGHT TEST MEASUREMENTS AND THEORETICAL CALCULATIONS
B Z Jenkins and A S Marks 1 Jan 1975 108 p refs
(DA Proj 1M2-62303-A-214)
(AD-A008965 RD-75-27) Avail NTIS CSCL 01/1

Downwash velocity data from a flight test of the UH-1M helicopter are presented in comparison with calculated values Hot film anenometers were used to measure flow velocities at five points in the downwash for a variety of aircraft forward velocities and hover The theoretical predictions were made using a mathematical model of sources and sinks to simulate the fuselage and vortex filaments to simulate the rotor wake Problems peculiar to the flight test are discussed GRA

N75-30129# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
METHOD OF DISCRETE EDDY ZONES FOR THE CALCULATION OF THE COMPONENTS THE TIME AVERAGE INDUCTIVE VELOCITY OF A HEAVILY LOADED PROPELLER
E D Safronov 20 Feb 1975 37 p refs Transl into ENGLISH from Uch Zap Tsentr Aerogidrodinamicheskii Inst (USSR) v 3 no 3 1972 p 45-53
(AD-A008732 FTD-MT-24-0327-75) Avail NTIS CSCL 01/1

Discrete vortex eddy belt zones are set up to determine the time average speed of an axial flow heavily loaded screw propeller Data show experimental and calculated values agree well with each other A solution was given to the problem of motion velocity for the free vorticity layer of the propeller E H W

N75-30130# Aerospace Systems, Inc Burlington, Mass
A STUDY OF TECHNIQUES FOR REAL-TIME, ON-LINE OPTIMUM FLIGHT PATH CONTROL ALGORITHMS FOR THREE-DIMENSIONAL, MINIMUM-TIME FLIGHT PATHS WITH TWO STATE VARIABLES Final Report, Dec 1973 - Nov 1974
Arthur E Bryson J Karl Hedrick, and William C Hoffman Dec 1974 35 p refs
(Contract F44620-72-C-0001, AF Proj 9769)
(AD-A008983, ASI-TR-74-20 AFOSR-75-0585TR) Avail NTIS CSCL 01/2

Study of three-dimensional, minimum-time turning maneuvers for supersonic fighter aircraft is described An optimization algorithm is developed for computing the minimum-time paths for specified initial energy final energy and heading change For turns which do not specify the final position the optimum maneuvers comprise a one-parameter family of flight paths All the optimum turns and their associated control variables can be presented in simple graphical form for a specified aircraft configuration A feedback control diagram can be easily implemented in the airborne computer to provide real-time on-line optimal flight path control The numerical optimization required can be simplified to such an extent that the feedback charts could be updated on-board for aircraft configuration changes and atmospheric variations Flow charts of the optimization algorithm are presented along with numerical results for an early model of the F-4 fighter GRA

N75-30131# Borst (Henry V) and Associates Wayne Pa
FLUID DYNAMIC LIFT, CONTENT SUMMARY Final Technical Report
Henry V Borst 30 Apr 1975 8 p refs
(Contract N00014-73-C-0354)
(AD-A009103 A001AG) Avail NTIS CSCL 01/1

The background and methods used in preparing and completing the remaining chapters for the book Fluid Dynamic Lift are discussed This book started by Dr Hoerner, is a logical follow-on to the book Fluid-Dynamic Drag and covers the factors involving lift in the same manner as was done in the drag book The chapters completed are discussed and major topics covered are given GRA

N75-30134# Neilsen 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 2 USER'S MANUAL FOR THE COMPUTER PROGRAMS Final Report, May 1972 - Aug 1974

Frederick K Goodwin and Marnix F E Dillenius Nov 1974 306 p refs

(Contract F33615-72-C-1375 AF Proj 8219)

(AD-A006158 NEAR-TR-65-Vol-2 AFFDL-TR-74-130-Vol-2) Avail NTIS CSCL 01/3

Detailed instructions are presented for using two computer programs which calculate the six-degree-of-freedom trajectories of external stores which are separated from fighter-bomber type aircraft at speeds up to the critical speed Single and multiple store configurations can be handled by the programs The first program calculates the source distributions which represent the volume distributions of the fuselage store(s), and ejector rack if one is present The second program uses a lifting-surface theory to determine a vorticity distribution which represents the wing and pylon loading and calculates the trajectory of the ejected store This report describes the two programs presents instructions for preparing input for the programs describes the output from each program, and presents sample cases GRA

N75-30135# Air Force Weapons Lab Kirtland AFB N Mex

THE APPLICATION OF PROBABILITY CALCULATIONS FOR BIRD AIRCRAFT STRIKE ANALYSES AND PREDICTIONS USING RADAR Final Report, Mar - May 1974

George E Meyer Mar 1975 20 p refs

(AF Proj 2103)

(AD-A008901 AFWL-TR-74-145) Avail NTIS CSCL 01/2

A theoretical development is given for the calculation of binomial probability distribution functions for assessing the risk of bird hazards to aircraft using radar A set of airspace cells is defined by beam geometry and pulse width and a given aircraft flight path, each with a determined number of birds Each distribution function can be studied to determine the maximum risk and corresponding number of birds involved The accumulative probability of bird strikes over an entire route can be determined by calculating the union of discrete cell probability sets GRA

N75-30136# Oakland Univ Rochester Mich Dept of Psychology

REDUCTION OF THE BAT HAZARD TO RANDOLPH AFB AIRCRAFT AFWL/AFOSR CONTRACT NO 73-187 Final Report, 10 Jul 1973 - 10 Jan 1975

Leonard C Ireland Victor A Harris, Sharon S Ireland Timothy C Williams and Janet M Williams 10 Jan 1975 63 p refs Prepared in cooperation with State Univ of New York, Buffalo

(Grant AF-AFOSR-2554-73)

(AD-A008972, AFOSR-75-0586TR) Avail NTIS CSCL 01/2

The airborne behavior of T b Mexicana emerging from and returning to the Bracken cave near Randolph AFB was observed with both search and height-finding radars Radar echoes from dense groups of bats covered areas as large as 1,500 square kilometers and rose to altitudes of over 3,000 meters Evening bat flights appeared to have three distinct phases of development exit from the roost and ascent, transition to level flight, and dispersal, In the dispersal phase the bats usually traveled directly toward Randolph AFB A bat avoidance program based on real time radar observations, was initiated at Randolph AFB during the summer of 1971 and continued through 1974 Since the start of the program, the frequency of engine damage has decreased It appears possible to predict nights when bat strikes are most likely to occur 24 hours in advance Strobe lights were found to be an ineffective bat deterrent GRA

N75-30137*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

THE 4D AREA NAVIGATION SYSTEM DESCRIPTION AND FLIGHT TEST RESULTS

Homer Q Lee Frank Neuman and Gordon H Hardy Washington Aug 1975 59 p refs

(NASA TN D-7874 A-5788) Avail NTIS HC $4 25 CSCL 17G

A 4D area navigation system was designed to guide aircraft along a prespecified flight path (reference path) such that the aircraft would arrive at the approach gate at a time specified by the ATC controller Key components to achieve this requirement were (1) stored reference trajectories (2) a continuously recomputed capture trajectory to a selected waypoint on the reference trajectory so as to achieve the desired time of arrival (3) electronic situation displays and (4) a control system to follow the overall trajectory in space and time The system was implemented in a digital integrated avionics system (STOLAND) installed on a CV-340 airplane Although the 4D system was designed primarily for automatic operation it was flight tested in a flight director mode (the pilot follows the flight director commands) because the CV-340 autopilot servos were not tied to the avionics system The flight test showed that, even in the flight director mode the pilot did achieve the objectives of path tracking and time of arrival control with only moderate workload The system also permitted controlled delay of the time of arrival by path stretching which takes advantage of the continuously changing capture trajectory to predict the time of arrival Simulations in the automatic and manual modes were used to complement the flight data Author

N75-30138*# Kanner (Leo) Associates Redwood City, Calif

THE LOGNORMAL FREQUENCY DISTRIBUTION OF A RANDOM DATA FLOW

H P Englmeier Washington NASA Aug 1975 12 p refs Transl into ENGLISH from Nachrichtentech Z (West Germany) v 28 Apr 1975 p 115-118

(Contract NASw-2790)

(NASA-TT-F-16515) Avail NTIS HC $3 25 CSCL 17G

Air traffic is simulated by a complex data processing system consisting of an air traffic simulator and the pilot system The information inputs and outputs of the pilot-operator system are recorded and analyzed to obtain information concerning the data flow between the simulator and the pilot system which might lead to propositions with general applicability for air traffic control It is found that the analyzed data flow is not based upon any systematic causes is subject to random distribution, and is a function of human factors Author

N75-30142# Syracuse Univ N Y Dept of Electrical and Computer Engineering

AN APPROACH FOR THE DESIGN OF AN AIR TRAFFIC CONTROL SYSTEM Interim Report, Aug 1972 - Nov 1974

Sun-Maw Yang and Tse-Yun Feng Mar 1975 199 p refs

(Contract F30602-72-C-0281)

(AD-A008795, TR-73-14 RADC-TR-75-64) Avail NTIS CSCL 17/7

Sophisticated air traffic control systems (ATCS) are becoming more and more urgently needed to accommodate increasing air traffic service demands and to resolve the various problems caused by such demands The goals of ATCS and the interrelations between them are delineated A generalized approach for the ATCS design is proposed so that further improvements on the ATCS is possible by more precisely modeling the craft capability, adding the new facilities in airports, in aircrafts and in control towers, and providing more information about many uncertain factors, such as noises, errors etc into consideration Purifying the data of aircrafts and generating crafts-situation-regulation commands are two major information processings done by ATCS, from which most of the goals of ATCS are to be achieved GRA

N75-30144 Aeroplane and Armament Experimental Establishment, Boscombe Down (England)

PUMA ENGINE POWER CHECKING USING COLLECTIVE PITCH

I A Fisher and T Opatowski 17 May 1973 30 p refs

(AAEE/Note-2081, BR35625) Avail Issuing Activity

A theory is presented which shows how the power output from a Turmo 3, C4 engine in a Puma helicopter can be expressed

in terms of collective pitch for level flight at 30 kt indicated airspeed It is shown how this could provide the basis for checking the power output of Puma engines in service tests Results indicate that the method proposed may just be accurate enough to detect a 4 percent deterioration in power output ESRO

N75-30145*# Boeing Vertol Co Philadelphia, Pa
CONCEPTUAL DESIGN STUDY OF A 1985 COMMERCIAL STOL TILT ROTOR TRANSPORT
C A Widdison, J P Magee and H R Alexander Nov 1974 256 p refs
(Contract NAS2-8048)
(NASA-CR-137601 D210-10873-1) Avail NTIS HC $8 50 CSCL 01C

Results of conceptual engineering design studies of a STOL tilt rotor commercial aircraft for the 1985 time frame are presented The details of aircraft size, performance, flying qualities noise and cost are included The savings in terms of fuel economy resulting from STOL operations compared with VTOL vehicles are determined Author

N75-30146*# Boeing Vertol Co , Philadelphia, Pa
CONCEPTUAL DESIGN STUDIES OF 1985 COMMERCIAL VTOL TRANSPORTS THAT UTILIZED ROTORS, VOLUME 1
J P Magee, R Clark, and H R Alexander Nov 1974 459 p refs
(Contract NAS2-8048)
(NASA-CR-137599, D210-10858-1) Avail NTIS HC $11 50 CSCL 01C

Results of conceptual design studies of commercial rotary wing transport aircraft for the 1985 time period are presented Two aircraft configurations, a tandem helicopter and a tilt rotor were designed for a 200 nautical mile short haul mission with an upper limit of 100 passengers In addition to the baseline aircraft two further designs of each configuration are included to assess the impact of external noise design criteria on the aircraft size weight, and cost Author

N75-30147*# Boeing Vertol Co Philadelphia, Pa
CONCEPTUAL DESIGN STUDIES OF 1985 COMMERCIAL VTOL TRANSPORTS THAT UTILIZED ROTORS, VOLUME 2
J P Magee R Clark, and H Alexander Nov 1974 407 p refs
(Contract NAS2-8048)
(NASA-CR-137600 D210-10858-2) Avail NTIS HC $10 50 CSCL 01C

Results of conceptual design studies of tilt rotor and tandem helicopter aircraft for a 200 nautical mile commercial short haul transport mission are presented The trade study data used in selecting the design point aircraft and technology details necessary to support the design conclusions are included Author

N75-30148*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
HUMAN COMFORT RESPONSE TO RANDOM MOTIONS WITH A DOMINANT TRANSVERSE MOTION
Ralph W Stone Jr May 1975 94 p refs
(NASA-TM-X-72694) Avail NTIS HC $4 75 CSCL 05E

Subjective ride comfort response ratings were measured on the Langley Visual Motion Simulator with transverse acceleration inputs with various power spectra shapes and magnitudes The results show only little influence of spectra shape on comfort response The effects of magnitude on comfort response indicate the applicability of psychophysical precepts for comfort modeling Author

N75-30149# Army Aviation Systems Command, St Louis, Mo
MAJOR ITEM SPECIAL STUDY (MISS), UH-1H MAIN MAST ASSEMBLY Interim Report, Jan 1964 - Jun 1974
Feb 1975 22 p
(AD-A006143 USAAVSCOM-TR-74-56) 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

N75-30150# Aerospace Medical Research Labs , Wright-Patterson AFB Ohio
AMRL REMOTELY PILOTED VEHICLE (RPV) SYSTEM SIMULATION STUDY 2 RESULTS
Robert G Mills, Robert F Bachert, and Milss M Aume Feb 1975 40 p
(AF Proj 7184)
(AD-A006142, AMRL-TR-75-13) Avail NTIS CSCL 01/3

The AMRL RPV System Simulation and Research Program was initiated in April 1973 in response to requirements for support of the design of the man-machine/environment interface of AF RPV systems The major objectives of the AMRL RPV System Simulation and Research Program are as follows (1) perform RPV system design evaluation studies i e evaluate alternative design configurations assumptions, operating procedures, etc , (2) assess RPV system effectiveness i e evaluate the expected effectiveness of a given system configuration such as its overall probability of achieving a target, etc (3) provide man-machine/environment interface engineering data i e evaluate effectiveness of contractor designed consoles, video bandwidth compression techniques GRA

N75-30151# Naval Air Development Center, Warminster Pa Air Vehicle Technology Dept
CATAPULT AND ARRESTED LANDING FATIGUE TESTS OF THE MODEL E-2A/B AIRPLANE Final Report
E F Kautz 17 Oct 1974 59 p refs
(AD-A005770 NADC-74199-30) Avail NTIS CSCL 01/3

A laboratory fatigue test was performed on an E-2 fuselage to determine if it could sustain the effects of 3000 arrested landings and 4000 catapult launches The right-hand keel beam failed after 4556 catapult test cycles Using a test scatter factor of 2 this is equivalent to 2278 service catapult launches The keel beam was repaired and modified and testing was continued until a total of 8000 catapult test cycles had been applied GRA

N75-30152# Air Force Inst of Tech , Wright-Patterson AFB, Ohio School of Systems and Logistics
AN ECONOMIC MODEL TO DETERMINE COSTS WHEN INTERMEDIATE LEVEL REPAIR USES REMOTELY LOCATED AUTOMATIC TEST EQUIPMENT M S Thesis
James T Garrett Jr and Neal W Gentry Jan 1975 112 p refs
(AD-A006341, SLSR-13-75A) Avail NTIS CSCL 15/5

Since the 1950 s the Air Force has recognized the advantages and flexibility of repairing items at the base or intermediate level However, over the past few years the increased complexity and sophistication of modern weapon systems has brought about the advent of complex and expensive automated test equipment In order to maintain the advantages of intermediate repair the expensive test equipment had to be procured for and maintained by the individual operating bases, thus producing a very high life cycle cost In an effort to reduce cost in the face of austere funding, a study was conducted to determine the economic feasibility of centralizing the automatic test equipment GRA

N75-30153# Air Force Flight Dynamics Lab , Wright-Patterson AFB, Ohio Flight Control Div
FORMULATIONS OF THE EQUATIONS OF MOTION OF AN ELASTIC AIRCRAFT FOR STABILITY AND CONTROL AND FLIGHT CONTROL APPLICATIONS

Robert C Schwanz Aug 1972 69 p refs
(AD-A006391, AFFDL/FGC-TM-72-14) Avail NTIS CSCL 01/1

This technical memorandum presents a derivation of the equations of motion for large and small disturbance perturbations from a reference state of motion The small perturbation equations of motion are then generalized to include the effects of atmospheric turbulence and gusts on the controls-free elastic aircraft The resulting equations are termed the EXACT formulation These EXACT equations may be used to evaluate the stability and performance of integrated flight control systems of the Control Configured Vehicle (CCV) type The equations are unique in that they describe a highly damped system using motion coordinates referenced to a body fixed, mean non-inertial axis GRA

N75-30154# Naval Air Development Center, Warminster, Pa Air Vehicle Technology Dept
INVESTIGATION OF HELICOPTER DOOR, WINDOW, AND ACCESS PANEL LOSSES Final Report
William Wiesemann and James McNamara 15 Jan 1975 56 p
(AD-A005882 NADC-74169-30) Avail NTIS CSCL 01/3

Door, window and access panel losses have occurred in a number of helicopters These losses are costly and cause safety problems to personnel and aircraft This report describes the investigation and analysis that was conducted to determine the major causes of helicopter panel losses and to identify those panels with high incidence of recurrence Conclusions have been drawn and recommendations made to improve retrofit and future design of aircraft GRA

N75-30155# United Aircraft Corp Stratford, Conn Sikorsky Aircraft Div
FABRICATED HELICOPTER TRANSMISSION HOUSING ANALYSIS Final Report, 18 Dec 1972 - 18 Oct 1973
Alexander Korzun and Stephen Schuman Jan 1975 298 p
(Contract DAAJ02-73-C-0022 DA Proj 1F1-62203-A-119)
(AD-A008995, USAAMRDL-TR-74-14) Avail NTIS CSCL 21/5

The helicopter transmission housing study provides a transmission housing design superior to the conventional magnesium cast housing The new design is a welded steel fabricated truss-like structure corrosion resistant and not susceptible to creep The aircraft selected for this study was the U S Army CH-54B helicopter The new fabricated truss-like housing was designed to be interchangeable with the present CH-54B magnesium main transmission housing It meets all the interface and functional requirements of the cast housing design Loads for flight and crash conditions as well as stiffness criteria, were developed to permit structural analysis and comparison with the existing casting design GRA

N75-30156# Menasco Mfg Co , Burbank Calif
SYSTEM MODIFICATION DATA MODIFICATION OF T-39 NLG DRAWINGS AND ANALYSES REFERENCE CONTRACT ITEM 0002, DATA ITEM A003
C Y Chu 27 Mar 1972 130 p Revised
(Contract F42600-71-C-1764)
(AD-A008651, SR034-Rev-B) Avail NTIS CSCL 01/3

The report contains the Static and Fatigue Stress Analysis and supplementary engineering data required to support the design changes for modification of the T-39 Nose Landing Gear Assembly GRA

N75-30161# Advisory Group for Aerospace Research and Development Paris (France)
POWER PLANT CONTROLS FOR AERO GAS TURBINE ENGINES
Klaus Bauerfeind and C Deane McCarthy May 1975 14 p refs Presented at 44th Propulsion and Energetics Panel Meeting Ustaoset Hoyfjellshotell Norway 9-13 Sep 1974
(AGARD-AR-80) Avail NTIS HC $3 25

The steady state and transient performance of aero gas turbine engines in a general fashion is treated Control concepts and computer simulation techniques are discussed and control system hardware is presented Author

N75-30167 Toronto Univ (Ontario) Inst of Aerospace Studies
JET AND AIRFRAME NOISE
Herbert S Ribner *In* AGARD Aircraft Noise Generation Emission and Reduction Jun 1975 17 p refs

Basic notions of acoustics (wave equation plane and spherical waves sources dipoles quadrupoles) are discussed along with an account of jet noise theory from the dilatation (simple source) point of view and from the equivalent quadrupole point of view The quadrupole sources are shown to dictate a basic directional pattern (self noise and shear noise) which is powerfully modified by convection and refraction effects The refraction by mean flow velocity gradients is illustrated by laboratory experiments Jet noise suppression theory examines the role of bypass ratio the mechanisms of multiple jet shielding and of reflective shielding by a surface or a gas layer Airframe noise, distinct from jet noise and other engine noise is traced to a number of sources on the aircraft Methods for estimating levels spectra and directivity are described Author

N75-30168 Toronto Univ (Ontario) Inst of Aerospace Studies
ATMOSPHERIC PROPAGATION AND SONIC BOOM
H S Ribner *In* AGARD Aircraft Noise Generation Emission and Reduction Jun 1975 11 p refs

The attenuation of sound by atmospheric molecular effects by turbulence and by near horizontal propagation near the ground is discussed along with refraction focussing, and defocussing effects shadow zones and diffraction into shadow zones Sonic boom is introduced as a 3D analog of the 2D V-shaped wave pattern of a boat Various aspects of sonic boom theory were developed evolution of the standard N-wave pressure v time signature nonstandard signatures for minimum boom, refractive effects leading to a sonic boom corridor and transonic cutoff maneuver effects leading to focussed superbooms and atmospheric effects leading to spiked and rounded boom signatures Author

N75-30170 Center for the Study of Noise in Society Glastonbury, Conn
JET ENGINE NOISE AND ITS CONTROL
John M Tyler *In* AGARD Aircraft Noise Generation Emission and Reduction Jun 1975 25 p refs

The noise of turbojet and turbofan engines is described and presented in a form useable by engine and aircraft designers it deals primarily with the practical aspects of aircraft powerplant noise Noise from the wakes of turbojet and turbofan engines, the effects of engine cycle on wake noise and the possibilities for noise reduction using exhaust noise suppressors are discussed Methods for exhaust noise prediction are presented Fan and compressor noise including a description of the mechanisms of fan and compressor noise generation was investigated Design practices to minimize fan and compressor noise are presented A discussion of turbine and combustion noise, and a summary of the state of the art in the research and development stage are included Author

N75-30171 Westland Helicopters Ltd , Yeovil (England)
ROTORCRAFT AND PROPELLER NOISE
Martin V Lowson *In* AGARD Aircraft Noise Generation Emission and Reduction Jun 1975 26 p refs

The fundamentals of propeller and helicopter noise radiation phenomena are presented including a review of the implication of subjective response Emphasis is placed on the underlying mechanisms of rotor noise generation both for discrete frequency

and broad band noise components Implications for noise control are discussed Author

N75-30172 Westland Helicopters Ltd Yeovil (England)
DUCT ACOUSTICS AND MUFFLERS
M V Lowson *In* AGARD Aircraft Noise Generation Emission and Reduction Jun 1975 34 p refs

The fundamental features of sound propagation in lined ducts with and without flow are reviewed Emphasis is placed on basic physical principles and simplified results A set of charts for direct evaluation of sound attenuation is given Detail predictions necessitate computer analysis based on the basic equations together with empirical engineering input on practical duct impedance boundary conditions The design of liners is discussed and the engineering trade-offs required in a practical aircraft design solution are reviewed briefly Author

N75-30178*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
PRELIMINARY STUDY OF THE FUEL SAVING POTENTIAL OF REGENERATIVE TURBOFANS FOR COMMERCIAL SUBSONIC TRANSPORTS
Gerald A Kraft Aug 1975 47 p refs
(NASA-TM-X-71785, E-8450) Avail NTIS HC $3 75 CSCL 21E

The fuel savings potential of regenerative turbofans was calculated and compared with that of a reference turbofan At the design altitude of 10 67 km and Mach 0 80, the turbine-inlet-temperature of the regenerative turbofan was fixed at 1700 K while the overall pressure ratio was varied from 10 to 20 The fan pressure ratio was fixed at 1 6 and the bypass ratio varied from 8 to 10 The heat exchanger design parameters such as pressure drop and effectiveness varied from 4 to 8 percent and from 0 80 to 0 90 respectively Results indicate a fuel savings due to regeneration of 4 1 percent and no change in takeoff gross weight Author

N75-30182# Bendix Corp South Bend Ind Energy Controls Div
TURBINE ENGINE CONTROL SYNTHESIS Final Technical Report
Samuel E Arnett Dec 1974 211 p refs
(Contract F33615-72-C-1716 AF Proj 3066)
(AD-A005817 ECD-863-18667-R AFAPL-TR-74-113) Avail NTIS CSCL 21/5

A highly versatile research type externally programmable control system for use in development and evaluation of new modes of control was assembled at the Air Force Aero-Propulsion Laboratory It includes sensors and transducers to measure and transform engine operating state engine geometry actuation devices and fuel control mechanisms a J85-13 engine mounted the cell of Room 21 Building 18C of the AFAPL a simulation of the J85 engine on the AFAPLs Applied Dynamics AD/Five Computer programs for the IBM 1800 computer to control the engine and the simulated engines and interface electronic equipment to complete the circuit between the digital computer engine-mounted equipment and the simulated engine GRA

N75-30187# Toronto Univ (Ontario) Inst for Aerospace Studies
CORRELATION OF JET NOISE DATA IN TERMS OF A SELF NOISE SHEAR NOISE MODEL
Nagy Sabet Mikhail Nosseir Jan 1975 44 p
(Grant AF-AFOSR-1885-70, AF Proj 9781)
(AD-A008899 UTIAS-TN-193 AFOSR-75-0496TR) Avail NTIS CSCL 21/5

The theoretical formalism of Ribner (1964 and 1969) was applied in the analysis of a large body of experimental jet noise data It was found that the basic directivity which results on excluding convection and refraction effects could be decomposed unambiguously into self noise and shear noise The basic self noise spectrum peaked approximately one octave higher than the shear noise spectrum and the peak amplitudes were roughly in the ratio two to one Upon frequency shifting and normalizing alignments the two spectra were found to match well in shape All these properties are in accord with the theory The self noise-shear noise spectral similarity was applied in a formalism for jet noise prediction utilizing the theory GRA

N75-30188# Teledyne CAE Toledo Ohio
LOW COST JET FUEL STARTER DESIGN STUDY Final Technical Report, 1 May - 2 Dec 1974
A Gabrys and R Smith 2 Dec 1974 103 p
(Contract F33615-74-C-2041 AF Proj 3145)
(AD-A008893 AFAPL-TR-74-104) Avail NTIS CSCL 21/5

This report presents the preliminary design and cost analysis of a low cost jet fuel starter This unit is an accessory to be used for starting main aircraft propulsion units and requires only jet fuel and battery power to achieve safe reliable starts The basic starter has a peak output of 150 horsepower is 10 0 inches in diameter 20 inches long and weighs 98 pounds The starter is capable of operating over an ambient temperature range of -65F to 130F and at altitudes up to 8 000 feet The design features a radial air inlet axial exhaust and a low speed concentric shaft with front power output The low speed (low stress) permits simple construction and low cost fabrication techniques with an overall reduction in total parts and cost when compared with typical high speed units The cost analysis indicates that the starter selling price is less than $8 000 per unit in quantities of 100 per year including tooling and R and D costs amortized over 2500 units GRA

N75-30189*# Stanford Research Inst Menlo Park Calif Information Sciences Lab
AIRCRAFT DIGITAL CONTROL DESIGN METHODS Monthly Progress Report
Michael G Tashker and J David Powell (Stanford Univ) Jun 1975 36 p refs
(Grant NsG-1137)
(NASA-CR-143321 MPR-6) Avail NTIS HC $3 75 CSCL 01C

Investigations were conducted in two main areas the first area is control system design and the goals were to define the limits of digitized S-Plane design techniques vs sample rate to show the results of a direct digital design technique and to compare the two methods the second area was to evaluate the roughness of autopilot designs parametrically versus sample rate Goals of the first area were addressed by (1) an analysis of a 2nd order example using both design methods (2) a linear analysis of the complete 737 aircraft with an autoland obtained using the digitized S-plane technique (3) linear analysis of a high frequency 737 approximation with the autoland from a direct digital design technique and (4) development of a simulation for evaluation of the autopilots with disturbances and nonlinearities included Roughness evaluation was studied by defining an experiment to be carried out on the Langley motion simulator and coordinated with analysis at Stanford Author

N75-30190*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
SUMMARY OF INFORMATION ON LOW-SPEED LATERAL-DIRECTIONAL DERIVATIVES DUE TO RATE OF CHANGE OF SIDESLIP BETA PRIME
Paul L Coe Jr A Bruce Graham, and Joseph R Chambers Washington Sep 1975 52 p refs Prepared in cooperation with Joint Inst for Acoustics and Flight Sci
(NASA-TN-D-7972 L-10112) Avail NTIS HC $4 25 CSCL 01C

The results presented show that the magnitudes of the aerodynamic stability derivatives due to rate of change of sideslip become quite large at high angles of attack for swept- and delta-wing configurations and that such derivatives have large effects on the calculated dynamic stability of these configurations at high angles of attack The wind-tunnel test techniques used to measure the beta prime derivatives and various approaches used to predict them are discussed Both the conventional

oscillating-airfoil theory and the lag-of-the-sidewash theory are shown to be inadequate for predicting the vertical-tail contribution to the acceleration-in-sideslip derivative, a flow-field-lag theory which is discussed appears to give qualitative agreement with experimental data for a current twin-jet fighter configuration
Author

N75-30191# Bell Helicopter Co Fort Worth Tex
FLIGHT CONTROL SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATIONS APPENDIX B SPECIFICATION REVIEW CHANCE RECOMMENDATIONS SYSTEM
John Zipperer, Gavin Jenney and Jerry Bryant Mar 1975 202 p
(Contract DAAJ02-73-C-0026 DA Proj 1F1-62203-A-119)
(AD-A009151 USAAMRDL-TR-74-57-App-B) Avail NTIS CSCL 01/3
The supplement to USAAMRDL-TR-74-57 covers review of specifications for helicopter flight control systems Recommended changes to the specifications are included in areas in which improvements could be made to requirements affecting system and mission reliability and maintainability GRA

N75-30192# Bell Helicopter Co Fort Worth, Tex
FLIGHT CONTROL SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATIONS APPENDIX C SPECIFICATION REVIEW CHANGE RECOMMENDATIONS, COMPONENTS, PART 1 Final Report
John Zipperer Gavin Jenney and Jerry Bryant Mar 1975 960 p
(Contract DAAJ02-73-C-0026, DA Proj 1F1-62203-A-11903)
(AD-A009152, USAAMRDL-TR-74-57-App-C-Pt-1) Avail NTIS CSCL 01/3
This supplement to USAAMRDL-TR-74-57 covers review of specifications concerning components of helicopter flight control systems Recommended changes to the specifications are included in areas in which improvements could be made to requirements affecting system and mission reliability and maintainability GRA

N75-30193# Bell Helicopter Co Fort Worth Tex
FLIGHT CONTROL SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATIONS APPENDIX C SPECIFICATION REVIEW CHANGE RECOMMENDATIONS, COMPONENTS, PART 2 Final Report
John Zipperer, Gavin Jenney and Jerry Bryant Mar 1975 921 p
(Contract DAAJ02-73-C-0026 DA Proj 1F1-62203-A-11903)
(AD-A009153, USAAMRDL-TR-74-57-App-C-Pt-2) Avail NTIS CSCL 01/3
This supplement to USAAMRDL-TR-74-57 covers review of specifications concerning components of helicopter flight control systems Recommended changes to the specifications are included in areas in which improvements could be made to requirements affecting system and mission reliability and maintainability GRA

N75-30194# Bell Helicopter Co Fort Worth Tex
FLIGHT CONTROL SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATIONS APPENDIX D SPECIFICATION REVIEW CHANGE RECOMMENDATIONS, STRUCTURE
John Zipperer Gavin Jenney, and Jerry Bryant Mar 1975 161 p
(Contract DAAJ02-73-C-0026 DA Proj 1F1-62203-A-11903)
(AD-A009154, USAAMRDL-TR-74-57-App-D) Avail NTIS CSCL 01/3
This supplement to USAAMRDL-TR-74-57 covers review of specifications concerning structural design of helicopters Recommended changes to the specifications are included in areas in which improvements could be made to requirements affecting system and mission reliability and maintainability GRA

N75-30195# Bell Helicopter Co Fort Worth Tex
FLIGHT CONTROL SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATIONS APPENDIX E SPECIFICATION REVIEW CHANGE RECOMMENDATIONS, COCKPIT ARRANGEMENT
John Zipperer, Gavin Jenney, and Jerry Bryant Mar 1975 41 p
(Contract DAAJ02-73-C-0026, DA Proj 1F1-62203-A-119)
(AD-A009155 USAAMRDL-TR-74-57-App-E) Avail NTIS CSCL 01/3
The supplement to USAAMRDL-TR-74-57 covers review of specifications concerning cockpit arrangements Recommended changes to the specifications are included in areas in which improvements could be made to requirements affecting system and mission reliability and maintainability GRA

N75-30196# Bell Helicopter Co, Fort Worth Tex
FLIGHT CONTROL SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATIONS APPENDIX F DESIGN HANDBOOK, DH-2-1, DH-2-X
John Zipperer, Gavin Jenney, and Jerry Bryant Mar 1975 167 p
(Contract DAAJ02-73-C-0026 DA Proj 1F1-62203-A-119)
(AD-A009156 USAAMRDL-TR-74-57-App-F) Avail NTIS CSCL 01/3
The supplement to USAAMRDL-TR-74-57 includes recommended changes to Design Handbooks DH-21 DH-2-X The changes recommended would help to improve requirements affecting system and mission reliability and maintainability GRA

N75-30197# Air Force Inst of Tech, Wright-Patterson AFB Ohio
DIFFERENTIAL THRUST CONTROLLER FOR AIR CUSHION LANDING SYSTEM AIRCRAFT M S Thesis
Matthew A Husson Dec 1974 108 p refs
(AD-A008662, GE/EE/74-51) Avail NTIS CSCL 01/3
A control system was designed to improve the heading response of the Air Cushion Landing System aircraft to differential thrust input The aircraft equations of motion and low speed stability derivatives were obtained from work done at the Air Force Flight Dynamics Laboratory at Wright-Patterson Air Force Base, Ohio Five different values of engine response time-delay were selected for the design study These time-delay values were 0 2 0 4 0 6 0 8, and 1 0 seconds The principle used for the design was to compensate the system ignoring the time-delay and then to compensate for the time-delay A two stage lead network was used to reduce the effect of the engine time-delay The system was simulated by using a digital computer program called MIMIC, which simulates the functions of an analog computer GRA

N75-30488# Air Force Systems Command Wright-Patterson AFB Ohio Foreign Technology Div
VISCOUS FLUID FLOW ON THE RIPPLED SURFACE OF THE SLIDING WING
V A Barinov and A V Zubtsov 26 Feb 1975 25 p refs Transl into ENGLISH from Tsentr Aerogidrodinamicheskii Inst Uch Zap (USSR) v 1, no 6 1970 p 75-81
(AD-A008764 FTD-MT-24-0374-75) Avail NTIS CSCL 20/4
The effect of the undulation of surface of an ideal flow around a wing was studied A numerical calculation of a three dimensional boundary layer of the wing is shown The distribution of heat fluxes on the wing is treated Surface undulation is shown to cause a change in flow characteristics J R T

N75-30596*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
AN IMPROVED METHOD FOR OPTIMUM DESIGN OF MECHANICALLY AND THERMALLY LOADED STRUCTURES
Howard M Adelman, Joanne L Walsh and R Narayanaswami Washington Aug 1975 35 p refs
(NASA-TN-D-7965 L-10161) Avail NTIS HC $3 75 CSCL 20K
The problem of obtaining the minimum-mass design of mechanically and thermally loaded structures is presented The special nature of thermal stresses with regard to their response to resizing of structural members is discussed It is shown that conventional resizing procedures which are based on driving the total stress to its allowable value may be inefficient when the

thermal stress in an element makes up a significant fraction of the total stress An improved algorithm for resizing of structures subjected to thermal stresses is treated In this algorithm the mechanical portions of the stresses were driven to their maximum allowable values The thermal stresses were used to adjust the allowable values of the mechanical stresses The new algorithm was exercised for a number of truss structures of varying complexity and compared with ordinary fully stressed design
Author

N75-30610# Air Force Rocket Propulsion Lab Edwards AFB Calif
BEHAVIOR OF CANTILEVER BEAM UNDER IMPACT BY A SOFT PROJECTILE Final Report, Jan - Aug 1973
Stephen W Tsai C T Sun A K Hopkins H T Hahn, and T W Lee Nov 1974 77 p refs
(AF Proj 7340)
(AD-A008778, AFML-TR-74-94) Avail NTIS CSCL 21/5

In an attempt to determine the maximum deflection and the ultimate strength of a fan blade under the impact of a bird, experiments were performed on the impact of cantilever beams by soft-rubber projectiles The observed response of the projectile and beam can be correlated with a simple analytic model - an equivalent mass-spring system which is derived from an assumed deflection mode The initial velocity of the equivalent mass immediately after impact is computed from the momentum conservation principle and measured coefficient of restitution This information and the dynamic characteristics of the equivalent mass-spring system are shown to be fairly sufficient to predict the behavior of the beam The success of this model implies that the structural response of fan blades under bird impact can be made predictable
GRA

N75-30671*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LOW ALTITUDE TEMPERATURE AND HUMIDITY PROFILE DATA FOR APPLICATION TO AIRCRAFT NOISE PROPAGATION
Andrew B Connor W Latham Copeland and Danny C Fulbright (Natl Climatic Center Asheville N C) Washington Sep 1975 60 p
(NASA-TN-D-7975 L-10117) Avail NTIS HC $4 25 CSCL 20A

A data search of the weather statistics from 11 widely dispersed geographical locations within the continental United States was conducted The sites located long both sea-coasts and in the interior span the northern southern and middle latitudes The weather statistics retrieved from the records of these 11 sites consist of two daily observations taken over a 10-year period The data were sorted with respect to precipitation and surface winds and classified into temperature intervals of 5 C and relative humidity intervals of 10 percent for the lower 1400 meters of the atmosphere These data were assembled in a statistical format and further classified into altitude increments of 200 meters The data are presented as sets of tables for each site by season of the year and include both daily observations
Author

N75-30995# Bundesministerium der Verteidigung, Bonn (West Germany) Ruestungshauptabteilung
CONTRIBUTIONS FROM MILITARY TECHNOLOGY [BEITRAEGE AUS DER WEHRTECHNIK]
Wolfgang Strathmann 1975 186 p refs In GERMAN, ENGLISH summaries
(BMVG-FBWT-75-12) Avail NTIS HC $7 00 Bundeswehramt DM 46 50

Experimental investigations of two types of supersonic rotors an impulse rotor and a shock in rotor configuration are reported A fatigue test program for life assurance of fighter aircraft is described, exemplified by the F-104G Results of thermal boundary layer measurements in the Baltic Sea using a thermistor cable are discussed Results are presented of investigations concerning the development of an electronically controlled phased array radar system

N75-30997 Industrieanlagen-Betriebsgesellschaft m b H Ottobrunn (West Germany)
LIFE ASSURANCE OF FIGHTER AIRCRAFT EXEMPLIFIED BY THE F-104 G [SICHERUNG DER LEBENSDAUER VON KAMPFFLUGZEUGEN DARGESTELLT AM BEISPIEL DER F-104 G]
T Gaymann and H J Zocher *In* Bundesmin der Verteidigung Contrib from Mil Technol 1975 p 44-75 refs In GERMAN ENGLISH summary

The fatigue life of the load carrying structure of modern fighter aircraft has caused some problems in the past 20 years in connection with the demand for advanced weapon techniques The reasons for these problems are briefly discussed Based on this experience and on the knowledge of numerous scientific investigations on the fatigue behavior of high strength materials and highly loaded structural components a method has evolved to ensure the required fatigue life of modern fighter aircraft The individual steps in the definition phase, the design phase, the qualification and the service phase are presented in block diagram form The improvements to be attained in applying this method are demonstrated by the results of the fatigue integrity program carried out for the F-104 G in German Author (ESRO)

N75-31004 Purdue Univ, Lafayette, Ind
THEORY OF AN AIRFOIL EQUIPPED WITH A JET FLAP UNDER LOW-SPEED FLIGHT CONDITIONS Ph D Thesis
Francis Louis Addessio 1974 147 p
Avail Univ Microfilms Order No 75-17143

A theory is developed for inviscid, incompressible flow past a thin airfoil equipped with a thin, part-span jet flap The theory is capable of treating low-speed flight regimes where the induced aerodynamic field of the jet is not small The resulting nonlinear problem is handled by treating the induced flowfields of the jet and the wing separately, obtaining the fully coupled solution in an iterative manner Spanwise variation of the jet vortex strength is assumed to be elliptical in the analysis Since the method considers the vorticity associated with the jet to be positioned on the locus of the jet, which is obtained in the solution, it is better able to evaluate subsidiary aerodynamic variables such as the downwash in regions aft of the wing as well as forces and moments on the wing A lifting surface theory is incorporated for the aerodynamics of the wing
Dissert Abstr

N75-31005 Georgia Inst of Tech, Atlanta
ANALYTICAL AND EXPERIMENTAL AEROELASTIC STUDIES OF A HELICOPTER ROTOR IN VERTICAL FLIGHT Ph D Thesis
Kanivenahalli Nagaraja 1975 153 p
Avail Univ Microfilms Order No 75-17491

The static aeroelastic analysis of a helicopter rotor blade is presented to study the elastic effects on inflow velocity distribution on the blade in hover or vertical flight The elastic deformation in the analysis is generally found to increase the inflow velocity as compared to a rigid blade assumption This increases the unsteady wake spacing in a flutter or response analysis Torsion-bending free vibration characteristics of the elastic rotor blade are determined for the boundary conditions employed in the experimental program, using the transmission matrix method These vibration characteristics and the available unsteady aerodynamic theory are used to obtain the response of the blade for an input excitation force The dynamic response characteristics of the two elastic model blades are experimentally studied Both the experimental and analytical response results for the speeds considered, show that there is an increase in positive aerodynamic damping with increase in speed except at certain speeds where the damped frequency ratio is near integer values The damped frequency is generally found to increase with speed
Dissert Abstr

N75-31007*# Virginia Univ Charlottesville Research Labs for the Engineering Sciences
UNSTEADY LOADS DUE TO PROPULSIVE LIFT CONFIGURATIONS Quarterly Progress Report, 1 Jul - 30 Sep 1975
Jeffrey B Morton, John K Haviland, George D Catalano and William W Herling Sep 1975 31 p ref

(Grant NGR-47-995-219)
(NASA-CR-143454 ESS-4043-108-75, QPR-7) Avail NTIS HC $3 75 CSCL 01A

The flow of a jet over an airfoil representative of upper surface blowing was studied using laser techniques Experimental techniques were developed for the investigation of unsteady pressures behind a cold model jet Construction of a 1/4 scale model of the 'Beach' test configuration was completed along with construction of a portable detector The portable detector is used in conjunction with a laser to measure jet flows during tests on the 'Beach' facility The detector incorporates both optical and electronic components Author

N75-31011*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
EFFECTS OF FORWARD CONTOUR MODIFICATION ON THE AERODYNAMIC CHARACTERISTICS OF THE NACA 641-212 AIRFOIL SECTION
Raymond M Hicks, Joel P Mendoza, and Angelo Bandettini Washington Sep 1975 76 p refs
(NASA-TM-X-3293, A-6018) Avail NTIS HC $4 75 CSCL 01A

Two different forward contour modifications designed to increase the maximum lift coefficient of the NACA 64 sub 1-212 airfoil section were evaluated experimentally at low speeds One modification consisted of a slight droop of the leading edge with an increased leading-edge radius, the other modification incorporated increased thickness over the forward 35 percent of the upper surface of the profile Both modified airfoil sections were found to provide substantially higher maximum lift coefficients than the 64 sub 1-212 section The drooped leading-edge modification incurred a drag penalty of approximately 10 percent at low and moderate lift coefficients and exhibited a greater nosedown pitching moment than the 64 sub 1-212 profile The upper surface modification produced about the same drag level as the 64 sub 1-212 section at low and moderate lift coefficients and less nosedown pitching moment than the 64 sub 1-212 profile Both modified airfoil sections had lower drag coefficients than the 64 sub 1-212 section at high lift coefficients Author

N75-31017# Imperial Coll of Science and Technology, London (England) Dept of Aeronautics
HEAT TRANSFER DISTRIBUTIONS ON A 70 DEG DELTA WING WITH FLAP-INDUCED SEPARATION
A J Edwards Mar 1975 48 p refs
(Contract MIN-DEF-AT/2037/105)
(IC-Aero-75-01) Avail NTIS HC $3 75

An experimental study of heat transfer distributions on the compression surface of a 70 deg delta at 8 2 M and a free stream Reynolds number of 170000/in is presented The tests were carried out in a hypersonic gun tunnel The model used was a swept plain-cropped delta wing with 70 deg sweep This had a trailing edge with incidence variable in 3 discrete steps between 10 and 30 deg Emphasis is placed on the flow separation induced by a trailing-edge flap, which is shown to be strongly dependent upon transitional effects for these flow conditions The experimental results are compared with pressure and flow visualization studies carried out on one delta wing (of 70 deg sweepback) with and without full-span trailing edge flaps ESRO

N75-31023# Air Force Academy Colo Frank J Seiler Research Lab
THE DYNAMICS OF A GROWING SEPARATED REGION ON AN AIRFOIL Final Scientific Report, Nov 1972 - Feb 1975
James D Lang Feb 1975 117 p refs
(AF Proj 7905)
(AD-A008773, SRL-TR-75-005) Avail NTIS CSCL 01/1

At present little is known of the dynamics of a separating and reattaching flowfield This unsteady flow topic relates to a wide range of aerodynamic problems such as dynamic stall and control-surface-buzz A theory is developed which models separation bubble dynamics It includes a quasi-steady model for the external shear-layer, and flow of mass within the bubble at a mean reversed-flow velocity Pressure perturbations along the bubble are modeled also The theory is based on experimental results for an airfoil with oscillating spoiler and flap GRA

N75-31038# Chrysler Corp , New Orleans, La Data Management Services
THE AERODYNAMIC CHARACTERISTICS OF WRAP-AROUND FINS, INCLUDING FOLD ANGLE AT MACH NUMBERS FROM 0 05 TO 1 3
C W Dahlke and L D Flowers 20 Dec 1974 519 p refs
(Contract DAAH03-74-C-0405, DA Proj 1M2-62303-A-214)
(AD-A009735, DMS-AR-1024 RD-TR-75-19) Avail NTIS CSCL 01/1

An experimental investigation was conducted in the transonic wind tunnel to study the aerodynamic characteristics of wrap-around fins Wrap-around fins with leading edge sweep angle on straight and step down bodies 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 1 3 at angles of attack up to 14 degrees and roll angles from 0 to 67 5 degrees The results of the test are presented in plotted form for the main balance and all four fin balances GRA

N75-31039# Ballistic Research Labs Aberdeen Proving Ground, Md
SOME AERODYNAMIC CHARACTERISTICS OF SUPERSONIC LIFTING BODIES Final Memorandum Report
Charles J Nietubicz Mar 1975 80 p
(AD-A009704 BRL-MR-2458) Avail NTIS CSCL 01/3

Aerodynamic characteristics are presented for various lifting body configurations Data were collected for an angle of attack sweep of -10 degrees to +10 degrees throughout a Mach number range of 1 5 to 4 0 The test Reynolds number per meter was 15,700 000 The data are presented as standard force coefficients which have additionally been transformed about a tunnel axis coordinate system to obtain lift and drag data The normal force center of pressure was found to be invariant with angle of attack and Mach number for all configurations GRA

N75-31051*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
WIND TUNNEL/FLIGHT DATA CORRELATION FOR THE BOEING 737-100 TRANSPORT AIRPLANE
Francis J Capone Aug 1975 18 p refs
(NASA-TM-X-72715) Avail NTIS HC $3 25 CSCL 01C

A brief wind-tunnel/flight data correlation for the Boeing 737-100 airplane was made The results showed excellent agreement between wind-tunnel and flight trimmed drag polars at Mach numbers less than 0 67 The wind-tunnel data predicted larger drag increments due to compressibility and a lift-curve slope about 9 percent higher than flight Author

N75-31052# Aeronautical Research Labs Melbourne (Australia)
AN INVESTIGATION OF THE FATIGUE PERFORMANCE OF THREE TYPES OF AIRCRAFT SKIN/SPAR BOOM FASTENING SYSTEMS PART 1 CONSTANT-AMPLITUDE FATIGUE TESTS
J Y Mann and F G Harris Sep 1974 55 p refs
(ARL/SM-Rept-350-Pt-1) Avail NTIS HC $4 25

Constant-amplitude fatigue tests were carried out at mean stress levels of 4,000 and 10,000 psi (28 and 69 MPa) using multifastener specimens as part of an investigation into the efficacy of several fastener systems for attaching sheet material to a heavy extruded section These included Parker-Kalon (PK) self-tapping screws, pinned Chobert blind rivets and BA screws The PK screw fastener system indicated superior fatigue strengths compared with all the other systems investigated They showed almost no tendency for the screws to loosen under fatigue loading, and exhibited considerably less scatter in endurance than the Chobert rivet system Markedly different fatigue fracture

characteristics were exhibited by divided sheet and full-sheet specimens, both as regards the fastener row at which the main fatigue fracture developed and also the origins of the fatigue cracks within the fastener holes Such differences could be relevant to the development of techniques and procedures for the detection and monitoring of small fatigue cracks The data support the contentions that less scatter in endurance occurs under conditions of multiple fatigue crack initiation in the plane of fracture than under single origin conditions Author

N75-31053# Technische Hogeschool Delft (Netherlands) Dept of Aeronautical Engineering
ESTIMATION OF THE AIRCRAFT STATE IN NON-STEADY FLIGHT
J A Mulder Oct 1974 22 p refs Submitted for publication (VTH-M-221) Avail NTIS HC $3 25

Kalman filtering and smoothing and maximum likelihood estimation techniques were applied to the problem of estimating the aircraft state in nonsteady flight from onboard noisy inertial and barometric measurements Applied to actual flight test data the estimation schemes yielded similar results Author (ESRO)

N75-31056# Bell Helicopter Co , Fort Worth, Tex
A NASTRAN VIBRATION MODEL OF THE AH-1G HELICOPTER AIRFRAME VOLUME 1 Final Report, Jul 1973 - Apr 1974
James D Cronkhite, Victor L Berry, and John E Brunken Jun 1974 423 p refs
(Contract DAAF03-73-C-0122)
(AD-A009482, BHC-209-099-432-Vol-1, RIA-R-TR-74-045-Vol-1) Avail NTIS CSCL 01/3

This report documents a NASTRAN finite element model of the AH-1G helicopter airframe The model was developed for the purpose of representing the low frequency vibration response of the airframe and the structure deflections due to weapon firing The NASTRAN input data deck for the model is included in the documentation as well as a Normal Modes run on Level 15 1 of the program The documentation is aimed at assuring that the government can independently use and modify the model to reflect actual or proposed changes in design It is assumed that government personnel using this model and documentation have a good understanding of the NASTRAN computer program GRA

N75-31057# Bell Helicopter Co , Fort Worth Tex
A NASTRAN VIBRATION MODEL OF THE AH-1G HELICOPTER AIRFRAME VOLUME 2 Final Report, Jul 1973 - Apr 1974
James D Cronkhite, Victor L Berry, and John E Brunken Jun 1974 639 p refs
(Contract DAAF03-73-C-0122)
(AD-A009483, BHC-209-099-432-Vol-2 RIA-R-TR-74-045-Vol-2) Avail NTIS

This report documents a NASTRAN finite element model of the AH-1G helicopter airframe The model was developed for the purpose of representing the low frequency vibration response of the airframe and the structure deflections due to weapon firing The NASTRAN input data deck for the model is included in the documentation as well as a Normal Modes run on Level 15 1 of the program The documentation consists mainly of drawings and sketches of the idealized NASTRAN model with supporting instructions In addition the actual structure is identified and the idealization of the structure as a finite element model is explained The NASTRAN input data deck serves as a major portion of the documentation GRA

N75-31058# Boeing Vertol Co Philadelphia, Pa
BALLISTICALLY TOLERANT ROTOR BLADE INVESTIGATION Final Report
Edward T Keast Apr 1975 117 p
(Contract DAAJ02-73-C-0098 DA Proj 1F1-63208-DB-52)
(AD-A009516 D210-10866-1 USAAMRDL-TR-75-4) Avail NTIS CSCL 01/3

The objective of this program was to design and test rotor blades that are more tolerant of ballistic damage than current blades Eight blade design concepts were conceived and compared with a previously tested baseline blade Three of these concepts were selected for fabrication and were ballistically tested Analysis of all hits showed a significant increase in survivability as well as a penalty in blade weight, for each of the three designs GRA

N75-31059# Technology Inc Dayton Ohio
FAIL-SAFE/SAFE-LIFE INTERFACE CRITERIA Final Report, Oct 1973 - Oct 1974
G V Feldt and S W Russell Apr 1975 169 p refs
(Contract DAAJ02-74-C-0004 DA Proj 1F1-62208-A-170)
(AD-A009519, USAAMRDL-TR-75-12) Avail NTIS CSCL 01/3

Preparatory to developing fail-safe/safe-life design criteria for future helicopters extensive literature and Go ernment/industry surveys were conducted to define and evaluate the related state of the art After selected fail-safe/safe-life design methodologies were defined they were applied to the main and tail rotor systems (specifically the blade, blade retention device, hub, and rotating controls) the fuselage, and the landing gear Next, in cost and weight trade-off studies various combinations of design criteria for redundant structures controlled-fracture structures and monolithic structures with slow crack growth were evaluated with respect to their technical feasibility GRA

N75-31060# United Aircraft Corp , Stratford Conn Sikorsky Aircraft Div
TIEDOWN AND BENCH TESTING OF GREASE-LUBRICATED HELICOPTER TAIL AND INTERMEDIATE GEAR-BOXES Final Report, Oct 1972 - Nov 1974
Bruce R Simmons Apr 1973 50 p
(Contract DAAJ02-73-C-00516 DA Proj 1F1-63209-DB-38)
(AD-A009757, SER-50902 USAAMRDL-TR-75-11) Avail NTIS CSCL 01/3

Experimental results are presented for modified, grease-lubricated H-3 intermediate and tail gearboxes operated on a regenerative test facility and an actual H-3 tiedown aircraft The H-3 intermediate and tail gearboxes were suitably modified for operation with grease lubrication and utilized a lubricant conforming to specification MIL-G-83363 (USAF) A 10-hour bench test was conducted followed by a 50-hour tiedown test on an NSH-3A aircraft GRA

N75-31061# Army Aviation Engineering Flight Activity, Edwards AFB Calif
FLIGHT EVALUATION ROSEMOUNT ORTHOGONAL LOW AIRSPEED SYSTEM LOW AIRSPEED SENSOR Final Report, 24 Jan - 9 Sep 1974
Robert P Jefferis, James C OConnor, and Jerry R Bullock Nov 1974 48 p refs
(AD-A009711, USAAEFA-71-30-5, FR-5) Avail NTIS CSCL 01/4

Tests were conducted on the Rosemount Engineering Company Model 853 orthogonal true airspeed sensor to determine its suitability for operational and flight test use as an airspeed system for helicopters The sensor has no moving parts and operates on the principle that differential pressures, measured between a pair of orthogonal chambers are proportional to the airspeed in a given direction Flight tests at Edwards Air Force Base, California were started on 24 January 1974 and were continued as additional hardware became available GRA

N75-31062# Technology Inc Dayton Ohio
DYNAMIC LOADS AND STRUCTURAL CRITERIA Final Report, Nov 1973 - Oct 1974
T L Cox, R B Johnson and S W Russell Apr 1975 199 p refs
(Contract DAAJ02-74-C-0017 DA Proj 1F2-62208-AH-90)
(AD-A009759, USAAMRDL-TR-75-9) Avail NTIS CSCL 01/3

Preparatory to developing mission profiles for future attack crane, observation assault, transport, and utility helicopters, the flight condition recognition (FCR) technique was applied to some 10-hour data samples for each of the following class-model

helicopters which had acquired 200 or more hours of multichannel oscillograph data during operational usage surveys while the helicopters operated under combat conditions in Southeast Asia (SEA) attack - AH-1G crane - CH-54A observation - OH-6A, assault - UH-1H transport - CH-47A and utility - UH-1H GRA

N75-31067*# Pratt and Whitney Aircraft, East Hartford, Conn
SUMMARY AND ANALYSIS OF PERFORMANCE AND STABILITY CHARACTERISTICS OF THE REFAN JT8D-109 ENGINE
K G Sanberg, R M Mogielnicki J C Davis, and V M Scaramella Sep 1975 117 p
(Contract NAS3-17840)
(NASA-CR-134874 PWA-5284) Avail NTIS HC $5 25 CSCL 21E

The refan JT8D-109 performance and stability characteristics are reported as determined from sea level testing, altitude testing and DC-9 flight testing The test results are summarized as follows (1) TSFC at SLS achieved design goal of 12 66 percent reduction, (2) TSFC at altitude average cruise power 0 5 percent higher than design goal, (3) TSFC at altitude maximum cruise power 1 7-3 7 percent higher than design goal, (4) ground starting consistent with JT8D-9 base engine (5) successful flight starts without starter assist, (6) transient surge margin equivalent to JT8D-9 (7) stable engine operation with inlet distortion, and (8) stable engine operation during snap acceleration and deceleration A flight idle setting is required for acceptable aborted-landing go-around acceleration time due to increase in low-rotor moment of inertia and a performance improvement program should be conducted as part of any future certification program Author

N75-31069* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
PROPULSION SYSTEM NOISE REDUCTION
Charles E Feiler Laurence J Heidelberg, Allan M Karchmer, Donald L Lansing, Brent A Miller and Edward J Rice *In its* Aeron Propulsion 1975 p 1-63

CSCL 21E

The progress in propulsion system noise reduction is reviewed The noise technology areas discussed include fan noise, advances in suppression including conventional acoustic treatment, high Mach number inlets, and wing shielding, engine core noise flap noise from both under-the-wing and over-the-wing powered-lift systems, supersonic jet noise suppression and the NASA program in noise prediction Author

N75-31070* National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
QCSSE PROGRAM
Carl C Ciepluch *In its* Aeron Propulsion 1975 p 65-80

CSCL 21E

The objectives scope, and status of the NASA Quiet Clean, Short-Haul Experimental Engine program are reviewed The progress reported is concerned with engine design concepts for short-haul aircraft where part of the engine thrust is used to help lift the aircraft Both under-the-wing, and over-the-wing configurations are discussed Author

N75-31071* National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
REFAN PROGRAM
Robert W Schroeder *In its* Aeron Propulsion 1975 p 81-97

CSCL 21E

The JT8D Refan Program for noise reduction is outlined, and the overall objectives and program status, test results, and current noise level predictions are presented Author

N75-31075* National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
COMPOSITES FOR FANS AND COMPRESSORS
Tito T Serafini *In its* Aeron Propulsion 1975 p 191-208 refs
CSCL 11D

The composites research being conducted at Lewis for the application of composite materials to fan and compressor blades is reviewed The major areas discussed include the development of improved materials and fabrication methods, recent progress in providing composite fan and compressor blades with improved resistance to foreign object damage and the development of advanced design and analysis procedures for composite blades Author

N75-31077* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
BEARINGS AND GEARS FOR ADVANCED TURBINE ENGINES AND TRANSMISSIONS
Richard J Parker *In its* Aeron Propulsion 1975 p 289-303

CSCL 21E

The improved technology is discussed of engine main-shaft ball bearings, and spur gears in power transmission drive trains Much of the technology can be applied to other ball and roller bearings and to other spur and bevel gears throughout the engine, drive train and accessory systems Author

N75-31079* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
ENGINE SYSTEMS TECHNOLOGY
Ross Willoh, Edwin J Graber, Fred Teren, and Robert E Coltrin *In its* Aeron Propulsion 1975 p 329-385 refs

CSCL 21E

Current full-scale engine development programs are discussed, and efforts to improve the available technology base are presented The Lewis full-scale engine test facilities are described Several typical engine programs and plans for research in aeromechanical instability or flutter are summarized An overview of Lewis studies of flow distortion and its effects on engine stability is presented The origins and nature of the distortion problem are summarized, and some of the results and methods for both steady and time-varying distortions are discussed Author

N75-31080* National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
PROPULSION SYSTEMS TECHNOLOGY
Kirby W Hiller Peter G Batterton, Paul L Burstadt, and John R Szuch *In its* Aeron Propulsion 1975 p 387-440 refs

CSCL 21E

The selection of components control design, simulation, and tests are examined for designing supersonic propulsion systems Inlet-engine combination under electronic control are shown Design and test results from the integrated control for afterburning turbofan and supersonic cruise inlet are presented Author

N75-31081* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
SUPERSONIC PROPULSION
John B Whitlow, Jr *In its* Aeron Propulsion 1975 p 441-457

CSCL 21E

The Supersonic Cruise Airplane Research (SCAR) technology program is reported Mission requirements, cycle considerations, engine evaluation, and SCAR test results are discussed It is concluded that improved aerodynamics and structures, greater use of composites and more-refined active controls are needed in the airframe area for designing an economically viable, environmental acceptable supersonic aircraft F O S

N75-31082* National Aeronautics and Space Administration Langley Research Center, Langley Station Va
HYPERSONIC PROPULSION

Griffin Y Anderson *In its* Aeron Propulsion 1975 p 459-474 refs
CSCL 21E

The NASA research on scramjet technology for speeds above Mach 5 is reported A brief overview of the NASA Hypersonic Research Engine (HRE) project is presented with emphasis on the most significant contributions on the HRE to scramjet technology The work on high-performance airframe-integrated scramjet engines is described, and a new versatile research airplane is discussed with emphasis on propulsion
Author

N75-31083# Advisory Group for Aerospace Research and Development, Paris (France)
DIAGNOSTICS AND ENGINE CONDITION MONITORING
Allen E Fuhs, ed , Richard Smyth ed H Dissen, ed Andrew Hess, ed , Dino Dini ed , Richard Lazarick, ed and W R Krupa, ed Jun 1975 342 p refs In ENGLISH partly in FRENCH Conf held at Liege, 4-5 Apr 1974
(AGARD-CP-165) Avail NTIS HC $9 50

Various engine monitoring techniques for aircraft turbine engines are summarized These methods range from boroscope inspection, SOAP, and radiography to advanced concepts in flight data analysis diagnostics, and prognostics Data also cover economics, statistics, and function of engine condition monitoring

N75-31085 Pisa Univ (Italy)
PROBLEMS IN FAULT DIAGNOSTICS AND PROGNOSTICS FOR ENGINE CONDITION MONITORING
M Andrenucci and R Lazzeretti *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 10 p refs

A general discussion of major problems concerning fault detection and isolation in ECM systems is presented The ECM concept, history and development prospects are reviewed, and various questions regarding instrumentation sensor requirements and some critical problem areas are considered A detailed discussion is presented on the concept of an ECM system designed to provide an extensive in-flight diagnostic and prognostic capability The main characteristics of such a system are analyzed, considering the various aspects of fault logic, parameter selection, diagnostic and prognostic procedures and system operation Hardware requirements and display techniques are also discussed
Author

N75-31086 Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France) Centre D'essais de Villa Roche
DIAGNOSIS OF THE FUNCTIONAL STATE OF A MOTOR BY MODELIZATION [DIAGNOSTIC DE L'ETAT DE FONCTIONNEMENT D'UN MOTEUR PAR MODELISATION]
A Barbot *In* AGARD Diagnostics and Engine In FRENCH

A mathematical model was used to investigate engine damage and its effects on engine operation and performance Two types of damage were considered damage which effects performance and that damage which does not effect performance In the case of performance effecting damage, thermodynamic parameters and the detection and localization of defects were discussed For non-performance effecting damage degradation or rupture of rotating parts and metallurgic degradation of mechanical components were considered Transl by E H W

N75-31088 Army Aviation Systems Command, St Louis, Mo
AUTOMATIC INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEM (AIDAPS) AN AUTOMATIC MAINTENANCE TOOL FOR HELICOPTERS
Thomas C Belrose In AGARD *Diagnostics and Engine Condition* Monitoring Jun 1975 8 p refs

An overall effort to develop an automatic inspection, diagnostic and prognostic system (AIDAPS) for US Army aircraft is summarized Major performance requirements of the AIDAPS system include continuous monitoring of critical systems, automatic diagnosis of malfunctions, and prediction of service life remaining in certain components The objective of this program is to develop, on existing aircraft and engines, AIDAPS systems for ultimate field application on future aircraft such as utility tactical transport aircraft system (UTTAS), heavy lift helicopter (HLH), and advanced attack helicopter (AAH)
Author

N75-31090 Grumman Aerospace Corp Bethpage N Y
ENGINE HEALTH AND FAULT DETECTION MONITORING ITS FUNCTION AND IMPLEMENTATION PROCEDURE
William Brenner *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 7 p refs

The realistic factors relative to an engine health and fault monitoring system and its functions and implementation are discussed as a basis for determining the performance condition and minimum maintenance duties of a high performance aircraft engine An approach to raise the user's confidence level will be discussed Opinions will be voiced with reference to whom should be involved in engine health and fault detection monitoring relative to concept formulation and design
Author

N75-31091 Riv-Officine di Villar Perosa S p A , Turin (Italy)
A CONTRIBUTION TO THE AERO ENGINES BEARINGS CONDITION MONITORING
S Brignone, G Fava, and F Giordano *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 20 p refs

From a survey of the existing techniques used to detect malfunctions in aircraft mainshaft bearings, it is concluded that they are mainly oriented toward the detection of the spalling fatigue initiation It is pointed out that high speed, low loaded bearings fail mainly from surface distress caused by roller skidding or deficiencies of the lubrication system and the conclusion is drawn that a new monitoring device should be developed based on the measure of the bearing internal speeds This device can detect bearing failures running conditions that might cause an early failure, and could also be used for calculating the bearing accumulated life Suggestions as to how to make the proposed measurements are given and some experimental data are presented
Author

N75-31093 Technische Universitaet Brunswick (West Germany) Inst fuer Maschinenelemente und Foerdertechnik
SOME EXPERIENCE IN ENGINE-TROUBLESHOOTING WITH INFLIGHT-DATA, RECORDED IN THE F-104G WITH THE LEADS-200
G Dahl *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 24 p

Inflight engine data, recorded during the flight test of the aircraft integrated data system (AIDS) LEADS-200 in the military fighter F-104G are processed to show their worth for accident investigation and early failure detection These investigations are performed in close connection with an airforce test station
Author

N75-31095 National Research Council of Canada Ottawa (Ontario)
IN-FLIGHT THRUST MEASUREMENT A FUNDAMENTAL ELEMENT IN ENGINE CONDITION MONITORING
M S Chappell and J A Gravelle (Computing Devices Co , Ottawa) *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 15 p refs

The development of an in-flight gross thrust measuring system, as applied to an afterburning turbojet engine with a fully-modulating variable-area nozzle is described The aerothermodynamic approach is described as background to the experimental results from both ground level test bed and flight trial using a CF-5D aircraft as a test vehicle
Author

N75-31096 Ohio State Univ , Columbus
VIBRATION DIAGNOSTICS IN HELICOPTER POWER TRAINS
D R Houser, M J Drosjack and G W Hogg (Army Air Mobility

R and D Lab, Ft Eustis, Va) *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 24 p refs

The state-of-the-art of vibration diagnostics is reviewed for gears and bearings and the potential application of these techniques to helicopter usage Related Army helicopter diagnostics research is also included The usage of diagnostic techniques with gears and bearings in helicopter power trains is similar to that which may be encountered on gas turbine engines A number of analysis procedures for diagnostic purposes were proposed, and some were tested The mesh forces will produce nonsinusoidal vibrations which appear in the frequence domain as a proliferation of harmonics and side-bands of the gear meshing frequency
Author

N75-31097 Aeronautical Systems Div, Wright-Patterson AFB Ohio
AN ADVANCED DIAGNOSTIC ENGINE MONITORING SYSTEM APPROACH
W R Krupa and K R Hamilton *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 11 p refs

The Advanced Diagnostic Engine Monitoring System (ADEMS) is designed to monitor all of the significant engine parameters in-flight and by the use of onboard digital computational techniques, compare the measured engine condition against normal expected design performance and also against test data related to component performance for a particular power setting When engine performance degradation is detected, the computer automatically interrogates other engine parameters to indentify and isolate the engine component(s) that are outside normal operating limits Out of tolerance readings are identified and the crew is alerted to the parameter(s) and component(s) that are outside normal operating limits Meanwhile, the computer automatically records engine parameters for post-flight analysis and long-term trending Recording, in this sense, is by exception in order to minimize the amount of post-flight analysis The expected payoff when an ADEMS type system is engineered and applied to military aircraft, is a sizable reduction of overall maintenance and operational costs, improved utilization of in-service engines and spare parts, and an in-flight capability to automatically isolate and assess the impact of engine component degradation
Author

N75-31098 Rolls-Royce, Ltd, Derby (England) Engine Div
ENGINE DATA RECORDING ON A PHANTOM AIRCRAFT RESULTS OBTAINED TO DATE
P A Mucklow *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 7 p

A recording system was installed in one Phantom aircraft expressly for recording Spey engine data This provides for continuous recording in digital form of signals from 21 parameters at a rate of 1 or 2 samples/second Significant results were obtained from this limited exercise
Author

N75-31099 Dornier-System G m b H, Friedrichshafen (West Germany)
EXPERIENCE WITH F-104G FDRS EVALUATION WITH RESPECT TO ENGINE DIAGNOSTICS
Bernd Mueller and Friedrich Bott *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 11 p

A Flight Data Recording System (FDRS) is being introduced in a German F-104G fighter bomber wing in order to establish FDRS technology and cost effectiveness of an operational system It is of particular interest to determine the possibilities and benefits of a most automatic debriefing after each flight in order to refine and verify present post flight check and pilot debriefing techniques For this purpose the conventional verbal pilot debriefing for maintenance is backed up by an automatic FDRS diagnosis evaluated by a ground computer within about 10 minutes time after landing
Author

N75-31100 North Carolina State Univ Raleigh Dept of Mechanical and Aerospace Engineering
TURBOJET ENGINE GAS PATH ANALYSIS A REVIEW
Frederick O Smetana *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 13 p

Methods for determining the thermodynamic health of a turbojet engine and of its major components are surveyed in a critical fashion from the point of view of their theoretical potential The quantitative effects of poor health on engine performance are detailed along with the inferences which can be drawn as to the reason for the poor health Instrumentation requirements of the various techniques are discussed The position of gas path analysis in an overall program of failure prediction is also treated
Author

N75-31101 Carleton Univ Ottawa (Ontario)
AN ENGINE ANALYZER PROGRAM FOR HELICOPTER TURBOSHAFT POWERPLANTS
L J Staples (Leigh Instruments LTD Ontario) and H I H SaraVanaMuttoo *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 9 p refs

A simple thermodynamic analysis technique was described, it was developed to sense the health of a helicopter power plant with a high degree of accuracy and sensitivity The main design objective was to develop a method of analysis which requires minimum computational power and yet will produce those cycle parameters which are prime indicators of engine condition The single-spool gas generator, free power turbine turboshaft was selected for consideration due to its almost universal application on present and forthcoming helicopter variants of interest
Author

N75-31104 KLM Royal Dutch Airlines, Amsterdam (Netherlands)
KSSU AIDS ENGINE ANALYSIS
H Vermeulen *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 27 p

Based on KLM s experience with a first generation digital AIDS the primary requirements for an AIDS for widebody aircraft included (1) a high degree of accuracy and repeatability, (2) a high system MTBF, and (3) integration with the ARINC 573 digital flight data recorder systems As the KSSU system concept was developed to meet not only ECM but also flight operational, flight technical and other requirements it is evident that a pure trade-off for ECM only becomes difficult
Author

N75-31105 National Aerospace Lab Amsterdam (Netherlands)
ENGINE CONDITION PROBLEMS IN SUPERSONIC FLIGHT
J P K Vleghert *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 6 p ref

A performance discrepancy of Royal Netherlands Air Force fighters could be traced to a mass flow deficiency at low corrected RPM Engine mass flow improved significantly when replacing the first stage compressor rotor blades Probable cause of the deficiency was air foil deterioration when applying an anticorrosion treatment to the blades
Author

N75-31106 British Airways Middlesex (England)
ENGINE HEALTH MONITORING IN A CIVIL AIRLINE
P Waller and E R White *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 14 p refs

The operational effects of prematurely failed engines are reviewed with estimated economic effects The estimated return from an engine health monitoring system is considered in relationship to the cost of implementing and running it, and it is shown that a positive financial return is only likely if the basic data acquisition and analysis equipments are readily available for other purposes The theoretical and experienced benefits are compared and the limitations imposed by operating such a system in a competitive commercial environment are discussed including the effects of stringent control over financial and personnel resources The results achieved so far are critically examined in terms of the equipment design specifications and actual

performance and also the mathematical processes employed in reducing the data Some of the deficiencies in these processes are discussed with proposals for their improvement The characteristics of the RB211 engines for BAED s next aircraft the TriStar, as relevant to engine health monitoring, are examined in relationship to the recording system to be fitted which includes a small but powerful computer with an input/output device for communicating with the flight crew Author

N75-31107 Pacific Airmotive Corp , Burbank, Calif Industrial and Marine Engine Div
AN INTEGRATED RELIABILITY PROGRAM UTILIZED FOR AIRCRAFT INDUSTRIAL AND MARINE GAS TURBINES
R E Weiller *In* AGARD Diagnostics and Engine Condition Monitoring Jun 1975 6 p refs

Both the airline and industrial gas turbine operators have the requirement for a comprehensive maintenance and reliability program which has the flexibility of accepting changes in concept as new technology is developed It was established and proven that on-condition and monitored maintenance type programs have not jeopardized or compromised safety or reliability Author

N75-31108*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
JET ENGINE AIR INTAKE SYSTEM Patent Application
Norman E Sorensen and Eldon A Latham inventors (to NASA) Filed 12 Sep 1975 21 p
(NASA-Case-ARC-10761-1 US-Patent-Appl-SN-612899) Avail NTIS HC $3 25 CSCL 21E

An axisymmetric air intake system for a jet aircraft engine comprising a fixed cowl extending outwardly from the face of the engine a centerbody coaxially disposed within the cowl and means for axially displacing the centerbody within the cowl is described The cowl and centerbody define a main airflow passageway In one embodiment a system for opening and closing the centerbody air inlet is provided by a dual-member centerbody, the forward member of which is displaced axially with respect to the aft member In a second embodiment, the centerbody air inlet may be opened and closed by means of doors located in the forward wall of a unitary-member centerbody The air intake system may also be provided with closeable air inlets located in the cowl wall which communicate with cowl auxiliary airflow passageways to provide auxiliary airflow to the engine Closeable bypass openings are provided which allow control of the normal shock wave within the main airflow passageway NASA

N75-31109# Institut Franco-Allemand de Recherches, St Louis (France)
CALCULATION OF BANG PROPAGATION IN REAL ATMOSPHERE FOCALIZATION GEOMETRY FOR CONCORDE ASCENT LAW AND BANG INTENSITY NEAR THE LONGITUDINAL AND LATERAL EXTINCTIONS [CALCUL DELA PROPAGATION DU BANG EN ATMOSPHERE REELLE POSITION GEOMETRIQUE DE LA FOCALISATION POUR LA LOI DE MONTEE DE CONCORDE INTENSITE DU BANG AU VOISINAGE DES EXTINCTIONS LONGITUDINALE ET LATERALES]
M Schaffar and F Schlosser 26 Apr 1974 74 p refs In FRENCH
(Contract DRME-73/191)
(ISL-11/74) Avail NTIS HC $4 25

The influence of meteorological conditions on the intensity and distributions of Concorde aircraft sonic boom was studied Computation parameters and flight conditions were defined Results show that the real atmosphere has definite effects on bang intensity and distribution as compared with standard atmosphere Directional wind effects and temperature effects are detailed ESRO

N75-31112# Transportation Systems Center Cambridge, Mass
NOISE EMISSIONS AND BUILDING STRUCTURAL VIBRATION LEVELS FROM THE SUPERSONIC CONCORDE AND SUBSONIC TURBOJET AIRCRAFT Final Report, Feb - Jun 1974
E J Rickley, R W Quinn, and N R Sussan Jun 1974 260 p
(PB-241384/7 DOT-TSC-OST-74-35) Avail NTIS HC $8 50 CSCL 01C

Noise emissions and building structural vibration levels were measured during landing and take off operations of the Anglo/French supersonic aircraft (Concorde) and from sone conventional subsonic turbojet aircraft Measurements were made at both the Fairbanks International Airport Fairbanks, Alaska and at the Logan International Airport, Boston, Massachusetts This report contains graphic level time history recordings tabulated peak RMS noise and vibration levels measured EPNL/PNLT history data and 1/3 octave frequency spectra of selected events GRA

N75-31116*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
AUTOMATIC GUIDANCE AND CONTROL OF A TRANSPORT AIRCRAFT DURING A HELICAL LANDING APPROACH
Daniel J Crawford Washington Sep 1975 57 p refs
(NASA-TN-D-7980 L-10101) Avail NTIS HC $4 25 CSCL 17G

A linear optimal regulator theory was applied to a nonlinear simulation of a transport aircraft performing a helical landing approach A closed-form expression for the quasi-steady nominal flight path is presented along with the method for determining the corresponding constant nominal control inputs The Jacobian matrices and the weighting matrices in the cost functional were time varying A method of solving for the optimal feedback gains is reviewed The control system was tested on several alternative landing approaches using both 3 deg and 6 deg flight path angles On each landing approach, the aircraft was subjected to large random initial-state errors and to randomly directed crosswinds The system was also tested for sensitivity to changes in the parameters of the aircraft and of the atmosphere Results indicate that performance of the optimal controller on all the 3 deg approaches is very good The control system proved to be reasonably insensitive to parametric uncertainties Performance is not as good on the 6 deg approaches A modification to the 6 deg flight path was proposed for the purpose of improving performance Author

N75-31117# Naval Postgraduate School, Monterey, Calif
FLIGHT DIRECTOR LAWS FOR THE LONGITUDINAL CYCLIC AND COLLECTIVE CONTROLS OF THE UH-1H HELICOPTER M S Thesis
Gordon Kenneth Smith Mar 1975 41 p refs
(AD-A009822) Avail NTIS CSCL 01/4

A technique for determining flight director laws for the longitudinal control of a V/STOL aircraft in landing approach is evaluated The method is based on the application of an optimal control model for the human pilot The vehicle studied was the UH-1H helicopter at three approach groundspeeds 60 knots, 40 knots, and 20 knots The two pilot outputs were longitudinal cyclic and collective In the analysis, ten pilot transfer functions which relate the two control variables to the five displayed and perceived quantities were obtained These transfer functions were then used to obtain the respective flight director laws GRA

N75-31276# United Aircraft Corp , East Hartford, Conn
DEVELOPMENT OF FIBER REINFORCED CERAMIC MATRIX COMPOSITES Final Report, Mar 1974 - Mar 1975
John J Brennan Feb 1975 69 p refs
(Contract N62269-74-C-0359)
(AD-A009360, UARL-R911848-4) Avail NTIS CSCL 11/4

Hot-pressed silicon nitride (Si3N4) is a leading candidate for use in advanced gas turbine engines Using an improved matrix material of Si3N4 - 10 wt % Y2O3 Ta reinforced Si3N4 composites have shown excellent thermal fatigue and thermal shock properties in addition to much improved impact resistance when compared to unreinforced Si3N4 Ballistic impact tests at 1300C have shown that the threshold energy below which no damage occurs upon impact for Si3N4-Ta composites is on the order of five times greater than for unreinforced Si3N4

Creep tests at 1300C, 15,000 psi, have shown the Ta reinforced Si3N4 - 10% Y2O3 sample performing as well, or even better than the unreinforced sample In addition component vane and wedge shapes of dense Si3N4 and Si3N4 reinforced with Ta wires have been formed with minimal finish grinding using the pseudo-isostatic hot-pressing technique GRA

N75-31378*# New York Univ N Y ERDA Mathematical and Computing Lab

ACCELERATED ITERATION SCHEMES FOR TRANSIONIC FLOW CALCULATIONS USING FAST POISSON SOLVERS

Antony Jameson Mar 1975 20 p refs Sponsored in part by ERDA

(Grants NGR-33-016-167 NGR-33-016-201)

(NASA-CR-143431 COO-3077-82) Avail NTIS HC $3 25 CSCL 20D

The use of a fast elliptic solver in combination with relaxation is presented as an effective way to accelerate the convergence of transonic flow calculations particularly when a marching scheme can be used to treat the supersonic zone in the relaxation process Author

N75-31463# Army Materiel Command Texarkana, Tex Intern Training Center

AN ANALYSIS OF THE CONCEPT OF TIME BETWEEN OVERHAUL LIMITS FOR AIRCRAFT COMPONENTS Final Report

John Thomas Stanfield Jr Mar 1975 61 p refs

(AD-A009187, USAMC-ITC-02-08-75-226) Avail NTIS CSCL 01/3

This report investigates the concept of scheduling aircraft component replacements on the basis of time between overhaul (TBO) limits The conditions under which the use of a TBO limit can be justified are examined Statistical and reliability theories applicable to planned replacement programs are studied Component failure characteristics assumed by classical reliability theory are compared with actual failure data for various types of aircraft components Finally, recommendations are presented for developing and managing a component TBO program GRA

N75-31638# Harvard Univ, Cambridge, Mass Div of Engineering and Applied Physics

ANALYTICAL AND NUMERICAL STUDY OF THE EFFECTS OF INITIAL IMPERFECTIONS ON THE INELASTIC BUCKLING OF A CRUCIFORM COLUMN Interim Report

J W Hutchinson and B Budiansky Dec 1974 16 p refs

(Grant AF-AFOSR-2476-73 AF Proj 9782)

(AD-A009162, DEAP-S-11, AFOSR-75-0605TR) Avail NTIS CSCL 20/1

The inelastic buckling of a cruciform column is investigated by a combination of analytical and numerical methods An exact asymptotic analysis for the effect of small imperfections on the maximum load reveals clearly how it is possible for an exceedingly small imperfection to have a very large influence As long as the strain hardening is sufficiently low, the numerical analysis confirms that Onat-Drucker conclusion that unavoidably small imperfections together with the use of J2 flow theory give rise to a maximum load prediction which is approximated by the bifurcation load prediction based on a deformation theory of plasticity GRA

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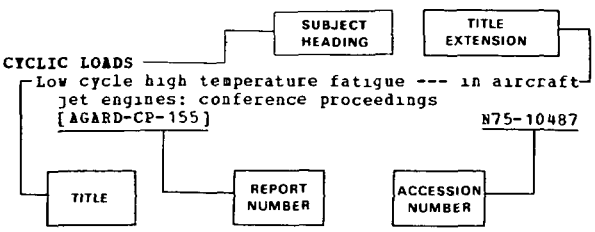

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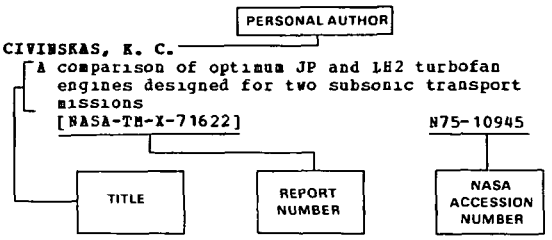

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