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A Continuing Bibliography with Indexes

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August 1979

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NASA SP-7037 (112)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 112

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 July 1979 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*

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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 Continuing Bibliography* (NASA SP-7037) lists 424 reports, journal articles, and other documents originally announced in July 1979 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* and *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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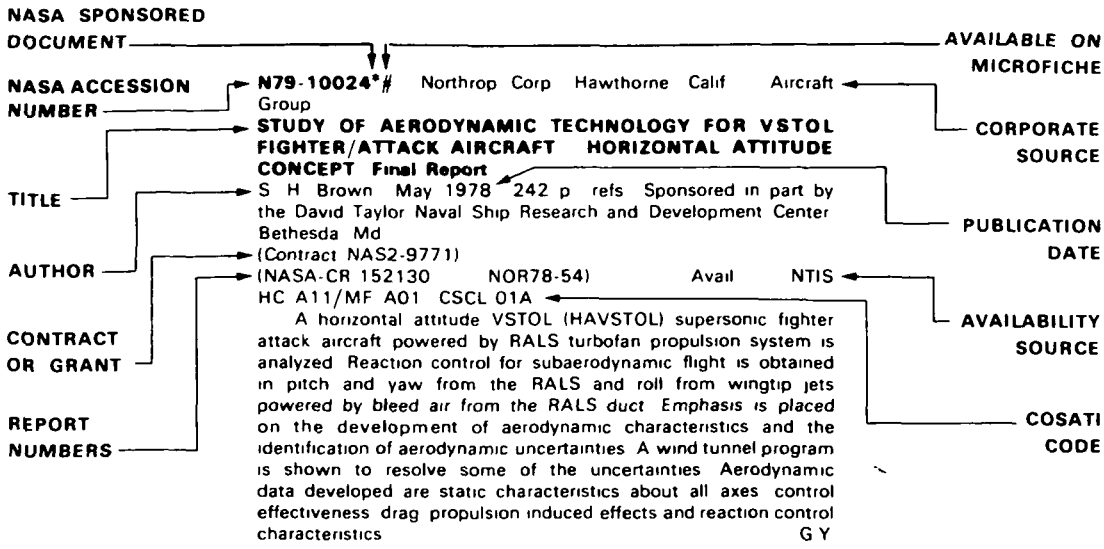

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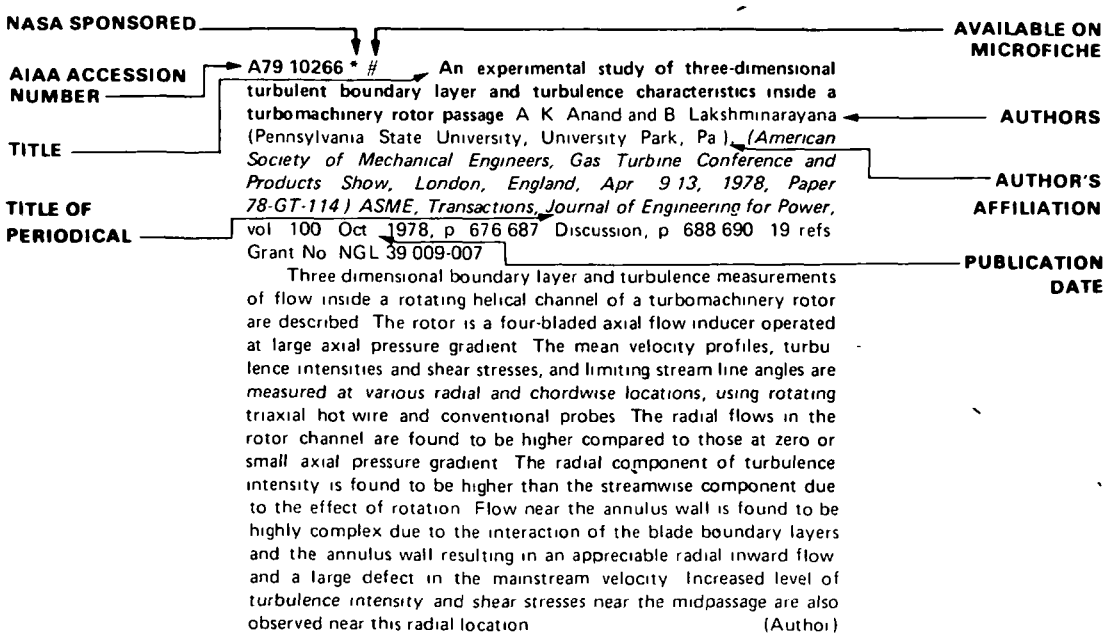

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 112)

AUGUST 1979

IAA ENTRIES

A79-32277 # **Recent progress in active controls applied to flutter suppressors (Récents progres sur les contrôles actifs appliqués aux suppresseurs de flottement)** R Destuynder *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 15th, Marseille, France, Nov 7-9, 1978, Paper* 20 p 7 refs In French

High subsonic wind tunnel testing has been conducted on an aeroelastic model of a military aircraft wing to which various stores were attached, the aim of the wind tunnel tests was to investigate flutter control through the introduction of stiffness in the wing Tanks and wing-tip stores were among the attachments mounted on the wing The flutter control law developed here may be applied to preliminary design studies, as well as to studies necessitated by the attachment of external stores to existing aircraft Problems related to the interaction of active control systems also receive attention

J M B

A79-32278 # **Aircraft response to lateral gusts- Exploratory study (Réponse de l'avion aux rafales laterales - Etude exploratoire)** J L Cocquerez and R A Verbrugge (Lille I, Université, Villeneuve d'Ascq, Nord, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 15th, Marseille, France, Nov 7-9, 1978, Paper* 35 p In French

A simulation procedure involving guided models in free flight has been developed for evaluating the effects of lateral gust loads on aircraft This paper describes the experimental method, the guidance procedure, and preliminary results Particular attention is given to the effects of lateral gusts during critical phases of the flight, including approach and landing in a cross wind

B J

A79-32288 # **Unsteady effects on a stalled wing in pulsed flow - Comparison with back-and forth oscillating case (Effets instationnaires sur un profil en decrochage dans un écoulement pulse - Comparaison avec le mouvement de tamis)** C Maresca, D Favier, and J Rebont (CNRS, Aix Marseille I, Universite, Marseille, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 15th, Marseille, France, Nov 7-9, 1978, Paper* 64 p 7 refs In French Direction Technique des Constructions Aéronautiques Contract No 77/9831300/481/7586

Unsteady effects on a symmetric NACA 0012 profile at 20 deg angle of attack in a pulsed flow were studied quantitatively and qualitatively on the basis of measurements of the wrench of aerodynamic forces, static pressure distribution, and wall shear stress distribution, and on the basis of flow visualization at different times of the pulse period The results are compared with those obtained previously for the same profile oscillating in a uniform flow, other conditions being equal The reciprocal nature of the two cases was revealed with regard to mean effects during a cycle, lift, drag, pressure distributions, and the vortex shedding mechanisms at the upper profile surface

P T H

A79-32290 # **Implementation of unsteady oscillatory flows in a transonic wind tunnel (Mise au point d'ecoulements instationnaires oscillatoires dans une soufflerie transsonique)** A Mignosi, J L Gobert, and C Quemard (ONERA, Centre d'Etudes et de Recherches de Toulouse, Toulouse, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquee, 15th, Marseille, France, Nov 7-9, 1978, Paper* 40 p In French

The first results obtained during the implementation of oscil latory flows in the injector-driven transonic wind-tunnel T2 at ONERA-CERT are presented and analyzed The oscillatory flow is obtained by making the downstream throat area periodically vary, owing to the rotation of a suitably shaped cam The study examines the characteristics of the unsteady flow in the test section and compares the results with those of computations based on the resolution of the unstationary equations, assuming the flow to be one-dimensional

(Author)

A79-32293 # **Review of problems of unsteady aerodynamics of helicopters (Synthèse des problèmes d'aerodynamique instationnaire de l'helicoptère)** J Gallot (Societe Nationale Industrielle Aérospatiale, Marignane, Bouches du Rhône, France) *Association Aéronautique et Astronautique de France, Colloque d'Aerodynamique Appliquée, 15th, Marseille, France, Nov 7-9, 1978, Paper* 20 p 34 refs In French

Various problems associated with unsteady rotor aerodynamics are surveyed and the practical impact of these problems on helicopter operation is discussed Various methods for incorporating these unsteady effects into the design procedure are examined, including aerodynamic models of the rotor, introduction of unsteady effects in the calculations, and unsteady two dimensional simulations Consideration of unsteady effects in models for predicting aerodynamic loads should make it possible to minimize such problems as stall flutter or Mach tuck

B J

A79-32294 # **Retreating blade and dynamic stall (Pale reculante et décrochage dynamique)** J Renaud (Societe Nationale Industrielle Aérospatiale, Division Helicopteres, Marignane, Bouches-du-Rhône, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 15th, Marseille, France, Nov 7-9, 1978, Paper* 23 p 16 refs In French

Simulations of dynamic stall on an oscillating airfoil show that stall delay, in unsteady regime, is associated with the development of an organized vortex system on the leading edge Two-dimensional tests permit deducing some synthetic laws for the occurrence of stall

P T H

A79-32295 # **Experimental studies of unsteady aerodynamics on wind tunnel models of helicopter rotors (Etudes expérimentales d'aérodynamique instationnaire sur des maquettes de rotors d'hélicoptere en soufflerie)** J-J Philippe, P Lafon, and J C Bohl (ONERA, Châtillon sous-Bagneux, Hauts-de Seine, France) *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 15th, Marseille, France, Nov 7-9, 1978, Paper* 11 p 10 refs In French Research supported by the Direction Technique des Constructions Aeronautiques

Test tools and facilities developed to analyze flows encountered on helicopter rotor blades are presented The measurements performed on straight or 30 deg swept blade tips reveal unsteady and three-dimensional effects on absolute pressure distributions The experimental data are also compared with calculations, which makes it possible to sum up the state of art for available prediction methods

(Author)

A79-32296 # **Study of compressor aeroelastic instabilities in a linear cascade wind tunnel (Etude des instabilités aéroélastiques des compresseurs en soufflerie de grille rectiligne d'aubes)** E Szechenyi, H Loiseau (ONERA, Châtillon sous-Bagneux, Hauts-de-Seine, France), and B Maquennehan (SNECMA, Moissy-Cramayel, Seine-et Marne, France) *(NATO, AGARD, Symposium on Stresses, Vibrations, Structural Integration and Engine Integrity, Cleveland, Ohio, Oct 23-27, 1978) ONERA, TP* no 1979-6, 1979 13 p 6 refs In French

A new linear cascade wind tunnel permits simulation of subsonic and transonic flows up to angles of attack of 12 deg and supersonic flows at fixed Mach numbers through the use of interchangeable nozzles First tests in the new facility have revealed several types of flutter A parametric study shows the effect of reduced frequency, angle of attack, pitch axis position, and Mach number P T H

A79-32302 # **Dynamic identification of light aircraft structures and flutter certification (Identification dynamique des structures d'avions légers et leur certification au flottement)** G Piazzoli and J -L Meurzec (ONERA, Châtillon sous Bagneux, Hauts-de-Seine, France) *(NATO, AGARD, Meeting, 48th, Williamsburg, Va , Apr 1-6, 1979) ONERA,* TP no 1979-31, 1979 20 p In French

The paper reviews some methods of quick identification of light aircraft structures and presents some of the calculation methods used Special attention is given to mixed methods, based on theoretical reconstruction of the contributions of the control surfaces in the structural modes revealed in tests, with a view to reducing the bad effects due to orthogonalization of the experimental mode basis with which the flutter prediction calculations were made P T H

A79-32305 # **Cost-effective production of flight vehicle shells by the pressure and flow-pressure processes (Kostengunstige Herstellung von Flugkorpergehausen im Druck- und Fliessdruckverfahren)** R Baumgartner (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber wirtschaftliche Herstelltechniken, Cologne, West Germany, Mar 28, 1979, Paper 79-008* 10 p In German

The paper describes two cold forming processes, the pressure and the flow-pressure methods, used to fabricate thin-walled tubular or ogive shell parts for flight vehicles The flow-pressure method has the advantage that eccentricities are eliminated Cheaper material can be used Long components with a bottom can be produced without welding A major disadvantage is that because of the spiral-shaped internal stresses, ovality appears during unilateral unloading P T H

A79-32307 # **Economical processing of fiber-reinforced components with thermal expansion molding (Wirtschaftliche Fertigung von Faserverbundbauteilen mit der Gummi-Expansions-Technik)** K Schneider (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft und Raumfahrt, Symposium uber wirtschaftliche Herstelltechniken, Cologne, West Germany, Mar 28, 1979, Paper 79-011* 33 p In German

The economic advantages in processing CFRP structures with thermal expansion molding are demonstrated on the example of a civil aircraft aileron consisting of 5 ribs, spars, and a cover layer It is shown that in a large-scale application of the technique there is a 25% gain in costs, and a 65% saving in material components A A

A79-32329 * # **An off-design correlation of part span damper losses through transonic axial fan rotors** W B Roberts (Nielsen Engineering and Research, Inc , Mountain View, Calif), J E Crouse, and D M Sandercock (NASA, Lewis Research Center, Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-6* 15 p 21 refs Members, $1 50, nonmembers, $3 00 Grant No NsG-3133

The experimental performance of 10 transonic fan rotors was used to correlate losses caused by midchord part-span dampers (PSD) during off design operation between 50 and 100 percent of design speed The design tip speed for the rotors used varied from 419 to 425 m/s and the design pressure ratios from 1 6 to 2 0 The loss attributable to the damper and the region influenced along the blade height was correlated with relevant aerodynamic and geometric parameters The losses at the design point were estimated by a previously reported correlation (Roberts, 1978) Using this as a base, the off-design losses were correlated with variation in blade suction surface incidence A check with independent data showed that the prediction of damper losses and region of influence was fair to good for most of the off-design data examined (Author)

A79-32330 # **Design and testing of two supercritical compressor cascades** H Rechter, P Schimming, and H Starken (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Antriebstechnik, Cologne, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-11* 11 p 7 refs Members, $1 50, nonmembers, $3 00

Two highly loaded supercritical compressor cascades (SKG 1 3 and SKG 2 7) have been designed and tested in order to demonstrate the applicability of supercritical airfoil technology to turbomachinery blading The blade geometry was calculated by an inverse numerical method starting from a prescribed velocity triangle and a blade surface pressure distribution which has been optimized through boundary layer calculations The cascade test results confirmed that supercritical airfoil technology is applicable to compressor bladings At design point conditions, minimum losses were found for both cascades, whereas the off-design performance was not satisfactory for the SKG 1 3 cascade To improve this, the second cascade SKG 2 7 has been developed with a modified pressure distribution This resulted in a considerably broader low-loss range with respect to inlet Mach numbers, whereas the incidence range could only be enlarged by 2 deg S D

A79-32334 # **A low cost, on-site performance monitoring system** H I H Saravanamuttoo (Carleton University, Ottawa, Canada) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-21* 6 p Members, $1 50, nonmembers, $3 00 Research supported by the National Research Council of Canada

A simple thermodynamic analysis for on site performance monitoring of shaft power gas turbines is described The method is simple, requires minimal extra instrumentation, yet permits the operator to determine the critical cycle parameters of turbine inlet temperature and airflow Computing requirements can be handled by a programmable calculator at minimum cost Experimental verification of the system showed very good agreement with engine tests (Author)

A79-32342 # **Shock boundary layer interaction on high turning transonic turbine cascades** C G Graham (Rolls-Royce, Ltd , Aero Div , Bristol, England) and F H Kost (Aerodynamische Versuchsanstalt Gottingen, Gottingen, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12 15, 1979, 79-GT-37* 13 p 12 refs Members, $1 50, nonmembers, $3 00

The paper presents the initial results of a cascade research program initiated in 1975 by Rolls Royce to provide information on the performance of transonic turbine profiles and, in particular, on the effect of shock boundary layer interaction Two different rotor blade profiles are designed to investigate the effect of blade back curvature on transonic blade performance The results are interpreted using Schlieren photographs to relate the transonic flow behavior to the cascade performance The suitability of Schlieren optics flow visualization for evaluating the results is discussed S D

A79-32343 # **Measurements of heat transfer in circular, rectangular and triangular ducts, representing typical turbine blade internal cooling passages using transient techniques** R W Ainsworth (Atomic Energy Research Establishment, Engineering Sciences Div, Harwell, Oxon, England) and T V Jones (Oxford University, Oxford, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79 GT-40* 8 p. 16 refs Members, $1 50, nonmembers, $3 00 Research supported by the Ministry of Defence (Procurement Executive) and Rolls Royce, Ltd

Internal convection cooling of turbine blades and nozzle guide vanes in jet engines is a method used to prolong the life of those components, which are subjected to very high temperature flows from the engine's combustion chambers The cooling is effected by passing cold gas through the internal coolant passages situated in the core of the components, the shape of these passages in many cases being simple duct geometries Experiments are described in which transient techniques were used in an internal flow facility to measure the flow property variation and heat transfer in various geometries simulating typical internal coolant passages, at conditions representative of those found in engines Results obtained from the three geometries studied (circular, rectangular, and triangular ducts) are compared with existing experimental data and an integral-approach theoretical prediction In addition, flow in the circular duct with mass removal representing film cooling mass flow was also studied experimentally, and these results are compared with theoretical predictions (Author)

A79-32348 # **An application of 3 D viscous flow analysis to the design of a low-aspect-ratio turbine** H C Liu, T C Booth (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz), and W A Tall (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79 GT-53* 9 p 8 refs Members, $1 50, nonmembers, $3 00 USAF sponsored research

Previously reported cascade test results verified and provided a calibration of the 3 D viscous flow analysis This paper describes the subsequent AFAPL sponsored technology program in which the 3-D viscous flow computer program was used to optimize the low-aspect ratio stator of a high-work turbine stage The optimization proce dure, in conjunction with the radial distribution of energy extraction, led to innovative-but-realistic blading for advanced gas gener ator turbines A turbine stage was tested with this stator, in conjunction with an appropriate rotor design The total to-total design point efficiency - 92 percent at 1 percent to clearance - was achieved at 31 83 Btu/lbm specific work In addition to stage tests, separate stator tests were conducted including a measurement of total pressure loss and stator reaction torque, which provided baseline data to assess interaction effects during stage testing with stator reaction measurements 'in vivo' (Author)

A79-32350 # **Unsteady upstream effects in axial-flow supersonic compressor stages** H E Gallus, K D Broichhausen (Aachen, Rheinisch Westfalische Technische Hochschule, Aachen, West Germany), and D Bohn (Kraftwerk Union AG, Mulheim, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12 15, 1979, Paper 79 GT-55* 9 p 18 refs Members, $1 50, nonmembers, $3 00

An investigation of the unsteady flow effects in a supersonic compressor stage is reported Semiconductor transducers mounted in the casing, a stroboscopic schlieren technique and probes equipped with semiconductor transducers were used to obtain unsteady static pressure, flow visualization and three dimensional flow information, respectively The throttling effect during the starting procedure of the stage was found to produce changes of the quasi steady and unsteady rotor flow pattern as well as changes in both amplitude and frequency of the flow disturbances at the inlet The conditions which are generated in this way at design speed are different from those reached by back pressure imposed on the started supersonic rotor at the same speed The relative position of rotor and stator has an influence on the flow field only below design speed One can conclude from the measurements of the rotor outlet angle that these effects generated by throttling the rotor flow by a stator during the starting procedure might be avoided with movable stator blades (Author)

A79-32351 * # **Laser balancing demonstration on a high-speed flexible rotor** R S DeMuth, R A Rio (Mechanical Technology, Inc, Latham, N Y), and D P Fleming (NASA, Lewis Research Center, Seals and Rotor Dynamics Section, Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79-GT-56* 6 p 6 refs Members, $1 50, nonmembers, $3 00 Contract No NAS3-18520

This paper describes a flexible rotor system used for two-plane laser balancing and an experimental demonstration of the laser material removal method for balancing A laboratory test rotor was modified to accept balancing corrections using a laser metal removal method while the rotor is at operating speed The laser setup hardware required to balance the rotor using two correction planes is described The test rig optical configuration and a neodymium glass laser were assembled and calibrated for material removal rates Rotor amplitudes before and after balancing, trial and correction weights, rotor speed during operation of laser, and balancing time were documented The rotor was balanced through the first bending critical speed using the laser material removal procedure to apply trial weights and correction weights without stopping the rotor (Author)

A79-32353 # **A general solution for distorted flows in cascades of aerofoils** M A El-Attar (Arab Organization for Industrialization, Helwan, Egypt) and R E Peacock (Cranfield Institute of Technology, Cranfield, Beds, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79-GT 65* 14 p 15 refs Members, $1 50, nonmembers, $3 00

The response of aerofoils in cascades to maldistributed inlet flows has been subject either to small perturbation analysis and to an actuator disk type of solution Such solutions are not able to account for realistic blade geometry or for significant flow variations over one blade pitch The general solution presented is capable of handling not only blade geometries involving large camber and chordwise thickness variation but accommodates the interference effect of adjacent blades in the presence of large and arbitrary shear intensity The main contribution of this work is the development of a nonlinear theory for nonuniform inviscid and incompressible cascade shear flow The theory is applied to results from experiments with an isolated aerofoil in shear flow and an encouraging level of agreement is found (Author)

A79-32364 # **Aerodynamic design of fixed and variable geometry nozzleless turbine casings** P M Chapple, P F Flynn, and J M Mulloy (Cummins Engine Co, Columbus, Ind) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper GT-87* 7 p 12 refs Members, $1 50, nonmembers, $3 00

A design method has been developed to produce nozzleless turbine casings which provide a centrifugal turbine wheel with a uniform inlet state The analysis includes the effect of wall friction and has been found to accurately predict the mass flow versus pressure ratio characteristics of nozzleless casings The uniform inlet state provided by this design approach provides turbine wheel/casing configurations with near optimum efficiency and a very low aerodynamic blade vibration excitation level The model has been extended to produce variable area casings to simulate a simplified variable casing geometry Testing has verified the accuracy of the approach both in the design point and variable geometry cases Also

depicted are new insights into turbine wheel design constraints discovered when using a variable geometry turbine casing (Author)

A79-32368 # **Surge-induced structural loads in gas turbines** R S Mazzawy (United Technologies Corp, Pratt and Whitney Aircraft Group, East Hartford, Conn). *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-91* 7 p 8 refs Members, $1 50, nonmembers, $3 00

The axial flow compression system of a modern gas turbine engine normally delivers a large quantity of airflow at relatively high velocity The sudden stoppage (and reversal) of this flow when an engine surges can result in structural loads in excess of steady state levels These loads can be quite complex due to inherent asymmetry in the surge event The increasing requirements for lighter weight engine structures, coupled with the higher pressure ratio cycles required for minimizing fuel consumption, make the accurate prediction of these loads an important part of the engine design process This paper is aimed toward explaining the fluid mechanics of the surge phenomenon and its impact on engine structures It offers relatively simple models for estimating surge induced loads on various engine components The basis for these models is an empirical correlation of surge-induced inlet overpressure based on engine pressure ratio and bypass ratio An approximate estimate of the post-surge axial pressure distribution can be derived from this correlation by assuming that surge initiation occurs in the rear of the compression system (Author)

A79-32371 # **Starting torque characteristics of small aircraft gas turbines and APU's** C Rodgers *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-95* 8 p 10 refs Members, $1 50, nonmembers, $3 00

Rapid starting at ambient temperatures as low as 65 F is often stipulated for small aircraft gas turbines and auxiliary power units Lubricant viscous drag in the mechanical drive train and accessories largely controls the starting torque characteristics of cold engines, the viscous drag is related to the magnitude of the applied start torque The weight of hydraulic start systems for auxiliary power units may nearly equal that of the unit itself A synergistic approach to starting torque characteristics is suggested to improve small gas turbine design J M B

A79-32375 # **An experimental study of endwall and airfoil surface heat transfer in a large scale turbine blade cascade** R A Graziani, M F Blair, J R Taylor (United Technologies Corp , East Hartford, Conn), and R E Mayle (Rensselaer Polytechnic Institute, Troy, N Y) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-99* 11 p 21 refs Members, $1 50, nonmembers, $3 00

Local rates of heat transfer on the endwall, suction, and pressure surfaces of a large scale turbine blade cascade were measured for two inlet boundary layer thicknesses and for a Reynolds number typical of gas turbine engine operation The accuracy and spatial resolution of the measurements were sufficient to reveal local variations of heat transfer associated with distinct flow regimes and with regions of strong three-dimensional flow Pertinent results of surface flow visualization and pressure measurements are included The dominant role of the passage vortex, which develops from the singular separation of the inlet boundary layer, in determining heat transfer at the endwall and at certain regions of the airfoil surface is illustrated Heat transfer on the passage surfaces is discussed and measurements at airfoil midspan are compared with current finite difference prediction methods (Author)

A79-32378 # **The influence of the blading surface roughness on the aerodynamic behavior and characteristic of an axial compressor** K Bammert (Hannover, Technische Universitat, Hanover, West Germany) and G U Woelk (Gutehoffnungshutte Sterkrade AG, Oberhausen, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-102* 5 p 6 refs Members, $1 50, nonmembers, $3 00

The conversion of energy in an axial compressor is influenced in great measure by the surface quality of the blading To achieve low flow losses, the roughness values of the blade surface must be below certain limits However, the blade surface, which is hydraulically smooth on commissioning of the machine, is in many cases attacked by dirt, corrosion and erosion during operation For investigation of the influence of the surface quality on the efficiency, flow rate, pressure ratio, and the shifting of the characteristic curves, systematic measurements were taken on a three-stage axial compressor with smooth and uniformly rough blading The roughness was produced by applying loose emery grain of different grades (Author)

A79-32383 # **Forced vibrations of a single stage axial compressor rotor** J A Fabunmi (Kaman Aerospace Corp , Bloomfield, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-108* 7 p 13 refs Members, $1 50, nonmembers, $3 00

A semi empirical method, utilizing modal analysis based on experimentally obtained modeshapes has been used to study the vibration response of a 23 bladed axial compressor rotor The system modeshapes, characterized by the blade deflections at resonance, are more or less irregular depending upon the proximity of the system frequencies to the blade cantilever frequencies The response of the detuned bladed disk assembly to various types of harmonic excitations are shown to be predictable if sufficient experimental information is available about the resonant modes and frequencies of the system (Author)

A79-32384 # **Friction damping of resonant stresses in gas turbine engine airfoils** J H Griffin (United Technologies Corp , Government Products Div , West Palm Beach, Fla) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-109* 5 p 7 refs Members, $1 50, nonmembers, $3 00

An approximate solution is presented to the problem of determining the resonant response of a turbine blade with a blade-to-ground damper The approach assumes that the damper is characterized by two parameters the force at which it slips, and its stiffness The effect of these parameters on the resonant response is assessed both analytically and experimentally Good agreement is found between theory and experiment The results suggest that the maximum amount of friction damping that can be achieved is an inherent property of the blade geometry Hence, by considering the derived amplitude reduction formula, it is possible to establish guidelines that can be applied in the early stages of blade design S D

A79-32385 # **The time-variant aerodynamic response of a stator row including the effects of airfoil camber** S Fleeter, W A Bennett, and R L Jay (General Motors Corp , Detroit Diesel Allison Div , Indianapolis, Ind) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT 110* 9 p 7 refs Members, $1 50, nonmembers, $3 00 USAF sponsored research

The paper outlines an experimental research program for quantitative determination of the validity and applicability of state-of-the-art transverse gust cascade analyses The rotor wake generated harmonic time-variant pressure distributions on both a classical flat plate and a cambered airfoil stator row are determined over a wide range of incidence angle values at realistic reduced frequency These dynamic data are all correlated with predictions obtained from a state-of the art compressible, zero incidence, flat plate cascade, transverse gust analysis with a view to determine its range of validity and to quantitatively assess the effects of airfoil

camber It is shown that compressibility is significant at high reduced frequency and low Mach number values, that the zero-incidence flat plate vane data correlate very well with the compressible flat plate predictions, and that the zero-incidence cambered airfoil vane row dynamic pressure coefficient data correlate well with the compressible flat plate prediction over the entire vane chord, and that the effect of airfoil camber is to increase the aerodynamic phase lag over the rear portion of the vane Other conclusions are also reported S D

A79-32386 # **Aerodynamic and aeroelastic characteristics of oscillating loaded cascades at low Mach number I - Pressure distribution, forces, and moments.** H Atassi and T J Akai (Notre Dame, University, Notre Dame, Ind) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-111* 8 p 11 refs Members, $1 50, nonmembers, $3 00 Grant No AF AFOSR-74-2675

An analytical solution is introduced which accounts for the singular behavior of the mean velocity gradient of oscillating cascaded airfoils in uniform incompressible flows The numerical procedure is such that all the terms of the boundary conditions at the airfoil surface are properly and completely considered Attention is given to a study of the unsteady pressure distribution, forces and moments for typical airfoil geometry and cascade parameters, and the results are compared with cases examined previously The basic characteristics of the unsteady pressure near the leading edge are investigated in view of its importance to flow separation and bubble formation It is shown that the strong mean velocity gradient near the leading edges of the airfoils significantly affects the unsteady pressure, forces and moments acting on the airfoils S D

A79-32387 # **Aerodynamic and aeroelastic characteristics of oscillating loaded cascades at low Mach number II - Stability and flutter boundaries** J T Akai and H Atassi (Notre Dame, University, Notre Dame, Ind) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-112* 5 p 11 refs Members, $1 50, nonmembers, $3 00 Grant No AF-AFOSR-74-2675

The aerodynamic coefficients obtained from the analysis developed in Part I of this paper are utilized here to investigate stability and flutter boundaries for loaded cascades of airfoils with finite thickness Combined bending and torsional oscillations for different stiffness ratios are studied for compressor and turbine cascades The results show very significant effects of blade geometry and mean flow incidence on the stability and flutter boundaries These effects are basically the consequence of strong coupling between the steady and unsteady aerodynamics of the cascade (Author)

A79-32389 # **Nuclear Bi-Brayton system for aircraft propulsion** B L Pierce (Westinghouse Electric Corp , Advanced Energy Systems Div , Pittsburgh, Pa) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-119* 10 p 7 refs Members, $1 50, nonmembers, $3 00 Contract No F33615 77-C-0116

Recent studies have identified and shown the desirability of a new system concept for nuclear aircraft propulsion utilizing a modification of a closed-cycle gas turbine This system concept, the Bi-Brayton system concept, permits coupling of a gas cooled reactor to the power transmission and conversion system in a manner such as to fulfill the safety criteria while eliminating the need for a high temperature intermediate heat exchanger or shaft penetrations of the containment vessel This system has been shown to minimize the component development required and to allow reduction in total propulsion system weight This technical paper presents a description of the system concept and the results of the definition and evaluation studies to date Parametric and reference system definition studies have been performed The closed-cycle Bi Brayton system and component configurations and weight estimates have been derived Parametric evaluations and cycle variation studies have been performed and interpreted The technical paper discusses the application of this new closed cycle gas turbine system to aircraft propulsion (Author)

A79-32392 # **Performance estimation of partial admission turbines** K Korematsu (Kogakuin University, Tokyo, Japan) and N Hirayama (Tokyo Metropolitan University, Tokyo, Japan) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-123* 9 p 6 refs Members, $1 50, nonmembers, $3 00

The new relationships of partial admission losses which account for influence of all major geometric parameters of concern to the turbine designer are presented, based on fluid dynamic analysis of the losses The performance maps are presented showing the trends in efficiencies that are attainable in turbine designed over a wide range of loading, axial velocity/blade speed ratio, Reynolds number, and aspect ratio Finally, the question of partial admission versus low aspect ratio is discussed (Author)

A79-32393 # **Modal analysis of gas turbine buckets using a digital test system** H A Nied (General Electric Co , Gas Turbine Div , Schenectady, N Y) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-124* 12 p 14 refs Members, $1 50, nonmembers, $3 00

A modal analysis was conducted on gas turbine buckets using a digital Fourier analyzer This digital test/computer system measures a set of frequency response functions for broadband impulse excitation at successive locations on the bucket airfoil From the set of frequency response functions, the analyzer computes the modal parameters used to determine the natural frequencies, critical damping ratio and mode shapes of the turbine buckets An animated display of the mode shapes for a discrete experimental model graphically revealed compound modes due to coupling The test has shown that the digital modal analysis using the impulse excitation techniques is rapid and precise experimental method to determine the modal parameters of turbine buckets with a high degree of repeatability (Author)

A79-32394 # **Optimization for rotor blades of tandem design for axial flow compressors** K Bammert (Hannover, Universitat, Hanover, West Germany) and R Staude (Gutehoffnungshutte Sterkrade AG, Oberhausen, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-125* 7 p 8 refs Members, $1 50, nonmembers, $3 00

The tandem cascades investigated consist of two retarding cascades closely arranged behind one another The influences of the flow interference for the pressure distribution at the profiles, for the losses and the outlet angle are discussed Various cascade configurations are theoretically and experimentally investigated to find out the optimum range of the axial spacing and for the displacement in circumferential direction An example shows how rotor blades of tandem design can be optimized for minimal profile losses The aim is to find the optimum configuration for each of the design sections of the rotor blades A further condition is to avoid additional bending stresses due to centrifugal forces, so that tandem rotor blades can run with relatively high speed (Author)

A79-32395 # **An analysis of aeroengine fan flutter using twin orthogonal vibration modes.** R A J Ford and C A Foord (Rolls-Royce, Ltd , Advanced Research Laboratory, Derby, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-126* 6 p 6 refs Members, $1 50, nonmembers, $3 00

Aeroengine fan flutter is analyzed in terms of twin orthogonal vibration modes (independent vibrations which are similar in shape

but have slightly different natural frequencies) and simplified aerodynamic theory Published flutter analyses use advanced aerodynamic models, but with simplified mechanical models The present approach shows that aspects of fan vibration which are ignored by the simplified models can significantly alter flutter behavior Flutter onset speed is shown to be affected by the natural frequency ratio of the two modes, as well as by the existing degree of damping Blade behavior is nonuniform around the fan, and the nature and extent of the nonuniformity is determined by the natural frequency ratio of the two modes and the degree of total damping in each mode (aerodynamic plus mechanical) S D

A79-32398 * # **Low-turbulence high speed wind tunnel for the determination of cascade shock losses** J A Slovisky (Notre Dame, University, Notre Dame, Ind), W B Roberts (Nielsen Engineering and Research, Inc , Mountain View, Calif), and D M Sandercock (NASA, Lewis Research Center, Fan and Compressor Branch, Cleveland, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-129* 11 p 23 refs Members, $1 50, nonmembers, $3 00

A low turbulence high speed wind tunnel, using anti-turbulence screening and a 100 1 contraction ratio, has been found suitable for high-speed smoke flow visualization The location and strength of normal, oblique, and curved shock waves generated by transonic or supersonic wind tunnel flow over airfoils or through axial compressor cascades is determined by combined shadowgraph and smokelines visualization techniques without the interference effects caused by intrusive probes The Reynolds number based on chord varied between 50,000 and 1,000,000 Preliminary results are compared with the relevant theory and data gathered using a total pressure probe (Author)

A79-32402 # **Oil squeeze film dampers for reducing vibration of aircraft gas turbine engines** T Miyachi (National Aerospace Laboratory, Tokyo, Japan), S Hoshiya, Y Sofue, M Matsuki, and T Torisaki (Aircraft Noise and Emission Research Group, Tokyo, Japan) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12 15, 1979, Paper 79-GT-133* 11 p 10 refs Members, $1 50, nonmembers, $3 00

Theoretical analysis and experiments were carried out on cylindrical oil squeeze film dampers The finite element method (FEM) was applied for calculating pressure distribution in the dampers with end seals and oil grooves Measurements of the viscous damping coefficient of several dampers were conducted and compared with theoretical values The effects of the dampers on the vibrational characteristics of engines were reviewed through theoretical analysis and experiments on an engine model Then, the effects of squeeze film dampers on an actual engine were evaluated for design information (Author)

A79-32405 # **A review of small gas turbine combustion system development** J A Saintsbury and P Sampath (Pratt and Whitney Aircraft of Canada, Ltd , Montreal, Canada) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-136* 10 p 13 refs Members, $1 50, nonmembers, $3 00

The EPA aircraft emission regulations were promulgated in 1973 and resulted in urgent investigations of many approaches aimed at reducing gas turbine emissions with minimum penalties to normal combustion performance The impact of this work on small aircraft gas turbine engines is discussed, and emission reduction techniques and data are presented Unique problems experienced with smaller gas turbine combustion systems are reviewed as are the potential difficulties of developing higher performance small combustors in the future, without the benefit of the complex and costly mechanical approaches which are applicable to the larger engines The impact of relaxed fuel specifications and alternate-source gas turbine fuels is discussed in terms of altered fuel properties and development of fuel injection technology (Author)

A79-32409 # **Thermal influences in gas turbine transients - Effects of changes in compressor characteristics** N R L MacCallum (Glasgow, University, Glasgow, Scotland) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-143* 8 p 17 refs Members, $1 50, nonmembers, $3 00

During transients of axial-flow gas turbines, the characteristics of the compressor are altered The changes in these characteristics (excluding surge line changes) have been related to transient heat transfer parameters, and these relations have been incorporated in a program for predicting the transient response of a single-shaft aero gas turbine The effect of the change in compressor characteristics has been examined in accelerations using two alternative acceleration fuel schedules When the fuel is scheduled on compressor delivery pressure alone, there is no increase in predicted acceleration times When the fuel is scheduled on shaft speed alone, the predicted acceleration times are increased by about 5 to 6 percent (Author)

A79-32411 # **Relationships for nozzle performance coefficients** E W Beans (Toledo, University, Toledo, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-145* 7 p Members $1 50, nonmembers, $3 00

The relationships between the performance coefficients for flow, kinetic energy, and thrust are developed for the irreversible adiabatic flow through a choked nozzle The basis of the development is maximum flowrate per unit area and an exit pressure greater than or equal to the exhaust pressure The relationships cannot be presented in explicit mathematical form However, from the application of linearizing techniques, linear relationships have been developed, which are accurate to within 0 1 percent The relationships allow one to determine two performance coefficients from empirical data for a single coefficient The relationships also allow one to predict difficult to measure flow properties such as the exit plane pressure for a choked nozzle The applicability of the development to supersonic and unchoked nozzles is discussed (Author)

A79-32414 * # **Elastomer mounted rotors - An alternative for smoother running turbomachinery** J A Tecza, S W Jones, A J Smalley (Mechanical Technology Inc , Latham, N Y), R E Cunningham (NASA, Lewis Research Center, Cleveland, Ohio), and M S Darlow *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-149* 6 p 25 refs Members, $1 50, nonmembers, $3 00 NASA-sponsored research

This paper describes the design of elastomeric bearing supports for a rotor built to simulate the power turbine of an advanced gas turbine engine which traverses two bending critical speeds The elastomer dampers were constructed so as to minimize rotor dynamic response at the critical speeds Results are presented of unbalance response tests performed with two different elastomer materials These results showed that the resonances on the elastomer-mounted rotor were well damped for both elastomer materials and showed linear response to the unbalance weights used for response testing Additional tests were performed using solid steel supports at either end (hand-mounted), which resulted in drastically increased sensitivity and nonlinear response, and with steel supports in one end of the rotor and the elastomer at the other, which yielded results which were between the soft- and hard-mounted cases It is concluded that elastomeric supports are a viable alternative to other methods of mounting flexible rotors, that damping was well in excess of predictions and that elastomeric supports are tolerant of small rotor misalignments (Author)

A79-32418 # **Effect of interblade phase angle and incidence angle on cascade pitching stability** F O Carta and A O Saint

Hilaire (United Technologies Research Center, East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-153* 6 p 15 refs Members, $1 50, nonmembers, $3 00 Contract No N00014-75 C 1143 Project SQUID

A comprehensive test program was conducted at low subsonic velocity on a linear cascade of airfoils oscillating in pitch about their midchords for incidence angles up to 10 deg, reduced frequencies up to 0 193, and over a range of interblade phase angles (sigma) from 60 to plus 60 deg For the range of parameters tested it was found that the interblade phase angle is the most important parameter affecting the stability of oscillating cascaded airfoils The system was unstable for most positive values of sigma over the entire range of loading and frequency System stability for negative values of sigma was more dependent on loading and frequency and conformed more closely to the observed behavior of stalled flutter B J

A79-32425 # **Engine evaluation of a vibration damping treatment for inlet guide vanes** J P Henderson (USAF, Materials Laboratory, Wright Patterson AFB, Ohio), L C Rogers, D B Paul (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio), and M L Parin (3M Co , St Paul, Minn) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-163* 9 p Members, $1 50, nonmembers, $3 00

Welded titanium inlet guide vanes in an Air Force turbojet engine, have been experiencing a high rate of vibration induced cracking after very short service The cause of this cracking has been identified as resonant vibration excited by pressure fluctuations occurring when the first-stage fan blades pass the inlet guide vanes A bonded vibration damping wrap has provided a cost effective fix which can be applied on a retrofit basis for major cost savings The damping wrap, which consists of multiple layers of energy dissipating adhesives separated by constraining layers of aluminum foil, is bonded to the vanes under high temperature and pressure in an autoclave This paper describes the results of engine test-cell tests and the comparison of these results with actual service experience obtained under operational conditions Measured effects on engine performance, distortion tolerance, and anti icing performance are presented along with measured stress reductions, as compared with increases in modal damping (Author)

A79-32426 # **The growth and evolution of the TPE331** J -P Frignac and E J Privoznik (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-164* 7 p Members, $1 50, nonmembers, $3 00

This paper describes the evolution of the Garrett-AiResearch TPE331 turboprop engine It discusses the reasoning behind the original design and describes the subsequent growth of the engine from 575 to 1040 hp within the same engine frame size The performance of the various models and the design features that provided minimum fuel consumption and maximum reliability are also discussed (Author)

A79-32427 # **The effect of a sample lot of fuel JECTORS on emissions levels of a small gas turbine** G Opdyke, Jr (Avco Corp , Avco Lycoming Div , Stratford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-165* 11 p 12 refs Members, $1 50, nonmembers, $3 00

The paper discusses the variability of emissions data measured in a test program where the fuel injectors were the prime test variable A single small gas turbine engine was tested twenty times within one month for emission levels The different fuel manifold and injector assemblies were tested Replicate tests were run and fuel type was varied as well The tests conducted indicate a significant variation in hydrocarbon and carbon monoxide emissions when fuel injectors are interchanged It is postulated that the variability of emissions is due mainly to large drops in the fuel sprays reaching and becoming entrapped in the wall cooling film, and that the number of large drops above a critical size varies among individual fuel injectors because of normal manufacturing tolerances S D

A79-32435 # **The combustion of a range of distillate fuels in small gas turbine engines** E Carr (Lucas Aerospace, Ltd , Fabrications Div , Burnley, Lancs , England) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-175* 9 p 5 refs Members, $1 50, nonmembers, $3 00

A compact engine configuration is obtained on small gas turbine engines by the use of a reverse flow annular combustion system Such combustion systems are usually of narrow width and of relatively large flame tube surface area/volume ratio In consequence, there is a tendency for excessive concentrations of fuel near to the flame tube internal surfaces and fuel impingement on the flame tube which can give rise to performance deficiencies, such as carbon build, loss of efficiency at low load conditions, smoke, and metal overheating particularly with fuels similar to ASTM D 975 Type 2-D diesel Since there is an increasing requirement for engines to operate with such heavier fuels, research and development programs were initiated to evolve an improved combustion system The paper briefly describes the main features of these work programs and outlines the configuration evolved and the performance achieved An arrangement has been obtained which gives a high standard of performance with fuels ranging from aviation kerosene fuel to gas oil and marine diesel (Author)

A79-32436 # **Improving turbine efficiency** K D Mach (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-176* 5 p 8 refs Members, $1 50, nonmembers, $3 00

A brief description is given of the turbine cooling research conducted by the Air Force Aero Propulsion Laboratory (AFAPL), along with a more extensive outline of the AFAPL programs in turbine aerodynamics, including applications of three-dimensional flow analysis The turbine design process consists of a cycle of preliminary aerodynamic and stress analyses, followed by detailed and elaborate analyses The preliminary analyses are iterative and serve to delimit the various design parameters, such as the flow path, the vector diagrams, the airfoil sections, the heat load on the airfoils, the required coolant, and the stress levels The turbine design is entering a period of rapid and profound change caused by the simultaneous advent of interactive graphics methods and a viable three-dimensional flow analysis S D

A79-32438 # **Fuel property effects on combustor performance** C A Moses and D W Naegeli (Southwest Research Institute, San Antonio, Tex) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-178* 11 p 13 refs Members, $1 50, nonmembers, $3 00 Contract No N00140-77-C-1345, Grant No DAAK70-78-C 0001

Two combustor rigs have been used to study the sensitivities of combustor operation to the physical and chemical properites of fuels Nineteen fuels including synfuels were used to accentuate the properties of concern composition, viscosity, and boiling-point distribution Flame radiation and smoke were best correlated by hydrogen content rather than hydrocarbon structure, the soot formation was due to gas phase reactions Lean blowout conditions were about the same for all fuels except that gasoline could be burned leaner at idle conditions Ignition limits were more sensitive to volatility than viscosity Gaseous emissions and combustion efficiency were not significantly affected by fuel properties although some sensitivity to boiling point distribution was evident In all

performance areas, the syncrude fuels correlated in the same ways as the petroleum-derived fuels except for the NOx emissions from the nitrogen containing shale oil fuel (Author)

A79-32440 # **Practical 'on-engine' microprocessor control and monitoring systems for gas turbines** N A Justice (Hawker Siddeley Dynamics Engineering, Ltd, Hatfield, Herts, England) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79-GT-181* 17 p Members, $1 50, nonmembers, $3 00

With the advent of the microprocessor, the conventional hydromechanical approach is being superseded by systems mounted directly on the gas turbine engine The paper discusses the single and twin gas turbine primary fuel control systems, along with such ancilliary controls as IGV, overspeed trip and reversionary or standby systems Attention is focused on choice of microprocessors, input/output structures, on engine package and its scope, reliability and integrity, failure of transducer, and a practical approach What has prevented an on-engine package before, viz vibration and temperature, is now well within the scope of the packaging engineer, because the size, weight and heat dissipation of microprocessor components are within usable limits S D

A79-32441 # **Three-dimensional lifting-surface theory for an annular blade row** G F Homicz and J A Lordi (Calspan Advanced Technology Center, Buffalo, N Y) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79-GT-182* 15 p 25 refs Members, $1 50, nonmembers, $3 00 Contract No F33615-76 C-2092

A lifting-surface analysis is presented for the steady, three-dimensional, compressible flow through an annular blade row A kernel function procedure is used to solve the linearized integral equation which relates the unknown blade loading to a specified camber line The unknown loading is expanded in a finite series of prescribed loading functions which allows the required integrations to be performed analytically, leading to a great savings in computer time Numerical results are reported for a range of solidities and hub-to-tip ratios, comparisons are made with both two-dimensional strip theory and other three dimensional results (Author)

A79-32442 # **A design review of ceramic components for turbine engines** P J Coty (USAF, Aero Propulsion Laboratory, Wright Patterson AFB, Ohio), A D Lane, J B Lee, and L J Meyer (AiResearch Manufacturing Company of Arizona, Phoenix, Ariz) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79-GT-183* 16 p Members, $1 50, nonmembers, $3 00 Contract No F33615-77 C-5171

The paper summarizes a program to evaluate the application of ceramic materials in small, limited-life turbine engines Advanced ceramics technology is employed in the program to achieve an affordable, reliable, high-performance capability for turbine engines in a missile application Design and material considerations are presented for ceramic rotor blades and stator vanes in addition to aerodynamic flow path analyses for ceramic components in high temperature environments An iterative materials/design analysis was made with use of probabilistic design methods to predict the survivability of the ceramic components Materials for both rotor blades and stator vanes were evaluated and selected based on mechanical and thermal stresses imposed by the optimum component design A number of design concepts for the primary components are reviewed These concepts include segmented-vane configurations and rotor airfoil shape and attachment schemes (Author)

A79-32443 # **The prediction of steady, circumferential pressure and temperature distortions in multistage axial flow compressors** H Mokelke (Motoren- und Turbinen- Union Munchen GmbH Munich, West Germany) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79-GT 184* 17 p 15 refs Members, $1 50, nonmembers, $3 00 Bundesministerium der Verteidigung Contracts No MTU-ZTL 4,05/7, No MTU-ZTL-4,05/8

It is desired to predict to circumferential pressure, temperature and velocity perturbations upstream, between the blade rows and downstream of a multistage, high hub-to tip ratio axial flow compressor subjected to a steady combined total pressure/total temperature inlet flow distribution For this purpose, an analytical model is developed which replaces the blade rows of the compressor by actuator disks located at the semichord position Due to this arrangement of the disks, the circumferential crossflow between the blade rows is overestimated, but this is neglected The restriction to a high hub-to-tip ratio compressor with a purely circumferential distortion allows to neglect radial variations in flow properties, so that the problem reduces to a two-dimensional one Although the formulated theory holds only for a cylindrical annulus of zero height with a constant radius to a first degree of accuracy, it can be applied to the mean section of the compressor or separately from stream surface to stream surface S D

A79-32445 # **Wind tunnel model study of the hot exhaust plume from the compressor research facility at Wright-Patterson Air Force Base, Ohio** G R Ludwig (Calspan Advanced Technology Center, Buffalo, N Y) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79-GT 186* 13 p 5 refs Members, $1 50, nonmembers, $3 00 Contract No F33615 76-C 2092

This paper presents the results of a wind tunnel model study to determine temperatures at various locations generated by the hot exhaust air from the Compressor Research Facility (CRF) which is being built at Wright Patterson Air Force Base, Ohio The study was designed to provide data at the inlet to the CRF and at other nearby locations where pedestrians, building ventilation systems, and vegetation might be affected The test program, which was conducted in the Calspan Atmospheric Simulation Facility, included flow visualization studies and quantitative concentration measurements of a tracer gas from which full scale temperature could be calculated The concentration measurements were performed for a number of wind speeds at each of twelve different wind directions Two exhaust flows and two exhaust stack configurations were studied (Author)

A79-32447 # **Catalytic combustion for gas turbine applications** W V Krill, J P Kesselring, and E K Chu (Acurex Corp, Energy and Environmental Div, Mountain View, Calif) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif, Mar 12-15, 1979, Paper 79-GT-188* 8 p 9 refs Members, $1 50, nonmembers, $3 00

Developments in catalytic combustion have shown increasing potential for application in gas turbine combustors Significant advantages in reducing combustor emissions, particularly nitrogen oxides (NOx), can be realized Both thermal and fuel NOx control were demonstrated for a developed graded cell catalyst concept Other criteria for catalyst scaleup and high pressure operation have been developed The concepts have been demonstrated in a catalytic model gas turbine combustor and a catalytic staged combustor The staged combustor shows great potential for control of fuel NOx New concepts in turbine combustors are required to implement catalytic combustion technology Gas turbine manufacturers were surveyed to identify design criteria The established criteria were prioritized and incorporated into several conceptual designs for the combustor Ongoing development will advance the concepts to prototype demonstration (Author)

A79-32452 # **Characteristic time correlations of pollutant emissions from an annular gas turbine combustor** A M Mellor (Purdue University, West Lafayette, Ind) and R M Washam

(General Electric Co , Schenectady, N Y) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT 194* 6 p 16 refs Members, $1 50, nonmembers, $3 00 Research supported by the U S Environmental Protection Agency

Gaseous emissions from aircraft gas turbines have been under study for about ten years In this paper, the characteristic time model for gaseous pollutant emission (NOx, CO) from conventional gas turbine engines is applied to the Pratt and Whitney JT9D annular gas turbine combustor Two can combustors, the GT-309 vehicular and T 63 helicopter burners, are considered for comparison purposes Attention is given to an examination of the universality of the correlations for these three gas turbine combustors Refinements of the characteristic time model as applied to JT9D are presented The significant new findings of the JT9D modeling effort are as follows (1) the combustor is annular but can be modeled as a can annular with CO surface area correction, (2) the burner is swirl rather than jet stabilized, which may be the cause of the small NOx correlation slope change observed As was the case for the T-63 combustor, the model includes fuel property variations as long as heterogeneous effects are negligible S D

A79 32457 # **Account of film turbulence for predicting film cooling effectiveness in gas turbine combustors** G J Sturgess (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15, 1979, Paper 79-GT-200* 16 p 13 refs Members, $1 50, nonmembers, $3 00

The liners of gas turbine combustion chambers are commonly film-cooled by tangential injection of cooling air along their flame side surfaces from one or more injection devices placed axially in the liner to form individual circumferential panels Practical geometry slots have a lower film effectiveness at ideal injection conditions than idealized slots with the same slot height and lip thickness The coolant film is modeled as three distinct regions, and the effects of injection slot geometry on the development of each region are described in terms of film turbulence intensity and initial circumferential nonuniformity of the injected coolant A prediction procedure for 'well designed' slots is presented which describes film growth downstream of the first of the three film regions S D

A79-32581 Geodesy and coordinate conversion for position determination of aircraft (Geodésie et conversion de coordonnees pour la localisation des avions) G Maignan (EUROCONTROL, Centre Experimental, Brussels, Belgium) *Navigation* (Paris), vol 27, Apr 1979, p 135 144 7 refs In French

A typical air traffic control problem in Western Europe involves the simultaneous determination of the positions of about 300 aircraft through radar measurements which may be based on different reference ellipsoids Additional difficulties arise from the inexactness with which certain radar station locations are known The errors in aircraft position determination resulting from the adoption of coordinate conversion techniques are examined, and the necessity of second-order approximations for some determinations is demonstrated J M B

A79-32582 Navigation by satellites (La navigation par satellites) E Giboin *Navigation* (Paris), vol 27, Apr 1979, p 145 159 In French

The Navy Navigation Satellite System, in public use since 1967, and the Navigation System with Time and Ranging/Global Positioning System (Navstar/GPS), which will enter service in 1985, are discussed Attention is also given to a French program, considered during the late 1960s, for a satellite based air traffic and marine navigation system for the North Atlantic Frequency bands, the protected and clear/acquisition codes, and the expected precision (five to six m) of the Navstar system are considered J M B

A79-32583 Air France's Paris-Tokyo transpolar flight in 1978 (Le vol transpolaire Air France, Paris-Tokyo, en 1978) P Hugon and J Fournier *Navigation* (Paris), vol 27, Apr 1979, p 180, 183-208 In French

The role of inertial navigation systems, the selection of navigation way points and the choice of cruising altitude for scheduled airline service between Paris and Tokyo are discussed The practical limits of usefulness of magnetic compasses in the polar region are considered, and emergency procedures for cases in which inertial navigation systems fail are reviewed The adoption of laser gyroscopes for future polar flights is also mentioned J M B

A79-32584 # **The powered glider, SZD-45A Ogar (Motoszybowiec SZD-45A Ogar)** T Labuc (Przedsiebiorstwo Doswiadczalno-Produkcyjne Szybownictwa, Bielsko-Biala, Poland) *Technika Lotnicza i Astronautyczna,* vol 34, Mar 1979, p 9-12 In Polish

The incorporation of a Stark 45 SG engine, provided by the firm Kuhn, West Germany, into a glider, manufactured by the Bielsko Works, is discussed The design of the craft is described in some detail, and its specifications are outlined V P

A79-32585 # **Designing aircraft shock absorbers (Projektowanie amortyzacji samolotu)** J Perlinski *Technika Lotnicza i Astronautyczna,* vol 34, Mar 1979, p 12 14 19 refs In Polish

The present paper deals with landing gear dynamics and the parameters which affect the aircraft at touch down and during the landing run The problem of designing landing gears for landing load requirements is examined V P

A79-32586 # **Research on the creep-rupture strength of aluminized and nonaluminized jet-engine turbine blades prepared from Nimonic 80A (Badania odpornosci na termozmeczenie aluminiowanych i niealuminiowanych lopatek turbin silnikow odrzutowych wykonanych ze stopu nimonic 80A)** Z Raczynski (Rzeszow, Politechnika, Rzeszow, Poland), R Szurlej, and L Wasko (Wytwornia Sprzetu Komunikacyjnego, Panstwowy Zaklad Lotniczy, Rzeszow, Poland) *Technika Lotnicza i Astronautyczna,* vol 34, Mar 1979, p 25, 26 In Polish

A79-32588 # **Numerical representation of aircraft geometry (Numeryczne odwzorowanie geometrii samolotu)** W Adamski *Technika Lotnicza i Astronautyczna,* vol 34, Mar 1979, p 29-31 7 refs In Polish

The paper deals with the numerical representation of curves and surfaces for use in shaping external aircraft parts Criteria for curve and surface fitting are proposed, along with a program for calculating surface coordinates on an arbitrary cross-sectional plane V P

A79-32589 # **Selected problems concerning unstable operation of aircraft turbine engine compressors (Wybrane problemy niestatecznej pracy sprezarek lotniczych silnikow turbinowych)** J Borgon *Technika Lotnicza i Astronautyczna,* vol 34, Mar 1979, p 33 35 5 refs In Polish

The paper deals with causes and mechanisms of instability of aircraft gas turbine compressors The symptoms and effects of compressor instability on the ground and in flight are discussed, along with methods of preventing instability V P

A79-32590 Numerical analysis of flow through turbine cascades by the Modified FLIC Method T Nagayama, T Adachi, Y Hayashi, and E Miyata (Mitsubishi Heavy Industries, Ltd , Nagasaki Technical Institute, Nagasaki, Japan) *Mitsubishi Heavy Industries Technical Review,* vol 15, Oct 1978, p 189-194 7 refs

This paper presents a numerical method used for the calculation of flow through turbine cascades Named the Modified FLIC Method, this numerical method uses the triangular finite difference mesh pattern which is different from the rectangular mesh pattern used for the conventional FLIC method Time-marching technique is

used, that is, starting with a given flow distribution, the calculation is repeated until a steady-state solution is obtained The computer program based on this method is very effective, for instance, the program has reduced the amount of work required for preparing input data in order to use automatic triangular mesh generation algorithm and it is capable of giving graphic results of calculation The results of the numerical calculation are compared with the optical experimental data obtained by using a shock tunnel It is found that there are satisfactory agreements between the calculated results and the experimental results (Author)

A79-32670 # **The flow past a supersonic trailing edge in transonic turbine cascades** R Dvorak, P Safarik, and V Vlcek (Ceskoslovenska Akademie Ved, Ustav Termomechaniky, Prague, Czechoslovakia) *Strojnicky Casopis,* vol 29, no 3, 1978, p 260-269 7 refs

The paper discusses the importance of the base pressure in the theoretical solution of transonic cascades and in their experimental research Results of a semiempirical investigation into the base pressure problem are presented A comparison with other elsewhere published data is given together with an example to check the applicability of the results (Author)

A79-32671 # **Some experimental results connected with the transonic instabilities on an airfoil** V Vlcek (Ceskoslovenska Akademie Ved, Ustav Termomechaniky, Prague, Czechoslovakia) *Strojnicky Casopis,* vol 29, no 3, 1978, p 342 354

The article describes the experimental research into the transonic instability of the flow field on an isolated airfoil and in a cascade The generation of disturbances in separated flow, propagation of waves from these sources upstream as well as their distortion and cumulation, which can cause the motion of the terminal shock is also described The formulas which have the direct relation to mentioned phenomena and which were obtained from the theory of propagation of weak waves and from the theory of waves of finite amplitude are given (Author)

A79-32722 **Omega - Global navigating by VLF fix** J F Kasper, Jr (Analytic Science Corp , Reading, Mass) and C E Hutchinson (Massachusetts, University, Amherst, Mass) *IEEE Spectrum,* vol 16, May 1979, p 59-63 6 refs

The Omega VLF system, expected to provide worldwide, all-weather position fixes with root-mean-square accuracy of 1-2 nautical miles, is discussed The evolvement of the system from World War II research on LF and VLF radiowave propagation is reviewed, together with a description of the signal format generator The position-fixing process, and the models employed to predict the behavior of VLF signals are examined, and it is shown that the position-fixing accuracy of Omega depends mainly on the ability to predict signal phase The program for collecting Omega phase data to support system calibration is noted, as are disruptive events, such as sudden ionospheric disturbances and polar cap absorptions System equipment costs are mentioned A A

A79-32734 # **Radiation field of a conformal phased array of rotational-polarization elements situated on a surface of revolution (Pole izluchenia konformnoi fazirovannoi antennoi reshetki elementov vrashchaiushcheisia polarizatsii, raspolozhennykh na poverkhnosti vrashchenia)** A A Klimashov and N P Mar'in *Radioelektronika,* vol 22, Feb 1979, p 66-69 In Russian

A79-32750 **Simulators cutting the fuel bill** M Hirst *Flight International,* vol 115, Apr 21, 1979, p 1241 1246

The current and future state of aircraft simulators is reviewed Airliner simulators are considered, with emphasis placed on CGI (computer generated image) units currently under development The PTT (part-task trainer) and the ACT (air-combat trainer) systems, used for military operations, are taken into account, as are general-aviation simulators Soviet airliner simulators, such as the Tu 154B2 and the Il-62M, are noted, together with a description of a single-seat combat aircraft simulator A A

A79-32751 **Designing, calculating, and manufacturing by means of data processing (Mit der Datenverarbeitung Konstruieren, Berechnen, Fertigen)** G Lang Lendorff (Kernforschungszentrum Karlsruhe GmbH, Karlsruhe, West Germany) *VDI-Z,* vol 121, no 7, Apr 1979, p 291-296 17 refs In German

The concept of the linking of tasks in the application of CAD/CAM (Computer aided design/computer aided manufacturing) is discussed CAD/CAM methods, particularly the treatment of geometrical objects, technical data base, and finite element method, are considered It is concluded that the development of program interlinking calls for a closer cooperation between developer and user A A

A79-32825 **Prospects of using wedge-shaped models for investigating thermal fatigue of turbine blades** L V Kravchuk (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *(Problemy Prochnosti,* Aug 1978, p 82-88) *Strength of Materials,* vol 10, no 8, Apr 1979, p 951-957 6 refs Translation

In the present paper, the adequacy of using geometrically nonsimilar models to study the thermal endurance of structural members with thermal stress raisers is evaluated on the basis of an analysis of the thermal stress strain state of wedge shaped models A nomogram for determining the proper dimensions of wedge shaped model (wedge angle radius of curvature of the edge, and chord length) is proposed, along with quantitative data for specifying means of controlling the thermal stress strain state of the wedge edge in the solution of modeling problems V P

A79-32827 **Damping capacity of paired shrouded turbine blades in relation to shroud contact conditions** V V Matveev, I G Tokar', S S Gorodetskii, and A B Roitman (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *(Problemy Prochnosti,* Aug 1978, p 93-97) *Strength of Materials,* vol 10, no 8, Apr 1979, p 962-966 5 refs Translation

A79-32828 **Evaluation of the aerodynamic damping of the oscillations of turbine blades with a view to pitch, stagger angle, and curvature of blades** V A Balalaev (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *(Problemy Prochnosti,* Aug 1978, p 98-103) *Strength of Materials,* vol 10, no 8, Apr 1979, p 967-973 10 refs Translation

A79-32919 # **Dynamic stability of a flight vehicle laying out an uncoiling line (Statecznosc dynamiczna obiektu latajacego odwijajacego z pokladu line)** T Kuzmicewicz (Wojskowa Akademia Techniczna, Warsaw, Poland) and J Maryniak (Warszawa, Politechnika, Warsaw, Poland) *Mechanika Teoretyczna i Stosowana,* vol 17, no 1, 1979, p 93 104 21 refs In Polish

A stability analysis is carried out for a flight vehicle (rocket) from the end of which a line uncoils into the rocket's wake The influence of the uncoiling line, of some parameters characterizing the ejection of the line, and of the geometrical and kinematic parameters of the rocket on its dynamic stability is examined The motion of the vehicle is described by nonlinear differential equations in a system of coordinates rigidly coupled to the rocket A linearized mathematical model of the system is obtained The solution of the linearized differential equation is reduced to the calculation of the eigenfunctions and the corresponding eigenvectors V P

A79-32934 # **Propulsion system considerations for the subsonic V/STOL** J D Cyrus, M DeVillier, Jr , and J Kaminski (U S

Naval Material Command, Naval Air Development Center, Warminster, Pa) *(American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-57) ASME, Transactions, Journal of Engineering for Power,* vol 101, Apr 1979, p 228-232 9 refs

A representative subsonic V/STOL aircraft operating on a single mission has been used as a baseline to investigate the impact of various propulsion system tradeoffs After establishing a cycle for the propulsion system and estimating V/STOL related installation penalties, parametric engine-aircraft-mission studies have been conducted These studies have established takeoff gross weight benefits of up to 13 percent that may be obtained by appropriate selection of the core engine sizing location Studies of two, three and four engine versions of the configuration have shown that three engine and four engine aircraft may have 20 percent lower weight than a two engine version, but this arises at the cost of significantly reduced hot section life (Author)

A79-32935 # **Measurement of heat-transfer rate to a gas turbine stator** M G Dunn and F J Stoddard (Calspan Corp , Buffalo, N Y) *(American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-119) ASME, Transactions, Journal of Engineering for Power,* vol 101, Apr 1979, p 275-280 20 refs Contract No F33615-76-C 2092

An experimental program has been undertaken to apply advanced shock-tube technology and well established transient test techniques to the measurement of heat transfer rates on a stationary inlet nozzle of a gas turbine engine The spatial distribution of the heat transfer rate is determined under gas dynamic conditions simulating engine operating conditions The accuracy of the heat transfer rate determinations is ensured by the clean, uniform and well known gas dynamic condition at the turbine inlet The experimental apparatus may also furnish useful cascade loss data J M B

A79-32936 # **Experimental study on diffusers for mixed-flow machines** T Sakai (Tokyo Science University, Tokyo, Japan), T Nakayama (Hitachi, Ltd , Hitachi, Japan), and M Sanbe *(American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT 120) ASME, Transactions, Journal of Engineering for Power,* vol 101, Apr 1979, p 281-289 6 refs

As a result of examining a relationship between inlet and inside flow patterns in the pure conical mixed flow diffuser, it was disclosed that a comparatively uniform flow in the diffuser would be obtained resulting in a good pressure recovery Also to find out an optimum configuration that would enable a stable and effective flow, tests on some model diffusers were made and the following was found the skewed flow in the pure conical diffuser was rectifiable by means of fitting some guide fences on the face of the diffuser inner wall, though a little twist was observed in the main flow between the inner and outer walls, a curved diffuser gave a slight improvement on the recovered pressure over the case of the pure conical one (Author)

A79-33024 **Measuring and improving ATC capacity** B Adderley *(International Federation of Air Traffic Controllers Associations, Annual Conference, 17th, Copenhagen, Denmark, Apr 24-27, 1978) The Controller,* vol 18, Mar 1979, p 7-10

Ways for measuring capacity and safety of an Air Traffic System are described, and the possibilities for improving traffic control procedures at low cost are explored The evolution of Air Traffic Control systems is considered, together with an evaluation of the need for analyzing system performance Factors that affect airspace capacity, including aircraft performance and approach procedures, are taken into account The use of analytical and simulation modes is discussed A A

A79-33025 **The principle and practice of 'clutch' radar operation** H W Cole (Marconi Radar Systems, Ltd , Chelmsford, Middx , England) *The Controller,* vol 18, Mar 1979, p 13-15

The so-called clutching principle, through which the radar needs of more than one airfield are served by a single radar, is discussed A method for quantifying the benefits derived from the principle is presented where the minimum expected value of the clutch factor results from the individual radars being close together The operation of the principle in practice is illustrated with an example, and it is shown that the necessary performance required can be provided by current equipments A A

A79-33201 **Gust spectrum fatigue crack propagation in candidate skin materials** R J H Wanhill (Nationaal Lucht- en Ruimtevaartlaboratorium, Emmeloord, Netherlands) *Fatigue of Engineering Materials and Structures,* vol 1, no 1, 1979, p 5-19 15 refs

Flight simulation fatigue crack propagation tests were carried out on 2024-T3, 7475 T761 and mill annealed Ti-6Al 4V sheet in thicknesses up to 3 mm and representative for transport aircraft lower wing skin stiffened panels of end load capacities 1 5 and 3 MN/m The performance of 2024 T3 was much superior, owing mainly to greater retardation of crack growth after severe flights The effect of load truncation was also greater for 2024-T3 The significance of the results for the choice of advanced structural concepts and materials and the choice of truncation level is discussed A recommendation for further investigation is given (Author)

A79-33456 **Computer-aided design - Aerodynamics** A B Haines (Aircraft Research Association, Ltd , Bedford, Beds , England) *Aeronautical Journal,* vol 83, Mar 1979, p 81-91 29 refs

The use of computers and advanced theoretical methods in aerodynamic design is reviewed Methods for calculating the supercritical flow over a two-dimensional airfoil are considered, with attention to variants of the Garabedian/Korn approach (1971) Design models of three-dimensional swept wing body combinations are taken into account, as are methods for multi-aerofoils, transonic methods for the flow over solid and ducted bodies, and second-order supersonic methods It is noted that new mathematical techniques which would radically reduce the computing times on a given machine are being investigated A A

A79-33457 **Advanced application of the MADGE approach aid offshore** R W G Clarke (M E L Equipment Co , Ltd , Crawley, Sussex, England) *Aeronautical Journal,* vol 83, Mar 1979, p 92-95

The application of the MADGE (Microwave Aircraft Digital Guidance Equipment) landing system to the Beryl 'A' platform in the North Sea, where multiple approach paths, offset in both azimuth and elevation are to be provided, is reviewed Offshore platform approach requirements are taken into account, and it is noted that at least four approach paths would be needed to mitigate the effects of the North Sea winds The operational procedures of the system are described, as is the program to certify MADGE for approach limits offshore of 150 ft minimum descent altitude and 300 m RVR equivalent to full civil aviation passenger carrying safety standards A A

A79-33458 **New technology S61N simulator** N D Hatfield (Redifon Simulation, Ltd , Crawley, Sussex, England) *Aeronautical Journal,* vol 83, Mar 1979, p 96 100

A simulator for the Sikorsky S61N has been installed at Dyce Airport, Aberdeen, England, to facilitate training of pilots to fly aircraft used for oil rig work in the North Sea The basic aspects of the training procedure are described, including preflight, departure, ILS approach, and emergencies on approach and letdown The simulator is discussed in detail, with emphasis on design features,

control feel and AFCS systems, and the Redifon SP1 night/dusk system The simulated ground stations are considered, noting that station information is stored on a data base A A

A79-33459 A research study into the reliability of various fuel, hydraulic and air conditioning components of military aircraft G W Bleasdale (British Aerospace, Warton Div , Preston, Lancs , England) *Aeronautical Journal,* vol 83, Mar 1979, p 101-105 Research supported by the Ministry of Defence (Procurement Executive)

Results of a research study on aircraft mechanical system components' defects are discussed Defects in fuel tank float switches are considered, noting that they can be grouped into seven broad categories, including quality control, high electrical load, rough handling, and contamination by fuel Defects relating to the operation of the fuel transfer pump, fuel valve actuator, hydraulic pump, pressure regulating valve, and cold air unit are also considered It is shown that 2% of the defects were due to external environmental conditions, such as altitude, rain, or corrosion, and 33% due to internal operating conditions, including vibration, voltage, and fatigue A A

A79-33460 Study of installed environment of various equipments in military aircraft. G Jones (British Aerospace, Brough, England) *Aeronautical Journal,* vol 83, Mar 1979, p 106 109 Research supported by the Ministry of Defence (Procurement Executive)

A mechanical systems component reliability study is used to discuss the effects of external environment- and internal operating-factors on the functional condition of an aircraft system or component Vibration levels, ambient temperature, fluid flow, corrosion, and contamination are taken into account Few defects were found to be due to external environment factors The internal operating factors, however, were shown to give rise to a significant proportion of the problems encountered A A

A79-33461 Some observations on the local instability of orthotropic structural sections. D J Lee (Nuclear Power Co , Ltd , Risley, Lancs , England) *Aeronautical Journal,* vol 83, Mar 1979, p 110-114

Wittrick has shown (1973) that it is possible to generate the buckling coefficient curve for a plate with clamped loaded edges and any side-conditions from the buckling coefficient curve for a plate with the same side-conditions but simply supported loaded edges The paper investigates this method in the context of its application to the local buckling of structural sections Particular emphasis is placed on the local instability of orthotropic channel sections, and a finite element analysis for this section is presented for comparison It is shown that an accurate estimate of the buckling coefficient for a column with simply supported or clamped end conditions can be obtained from the quantities K-min (where K-min is the minimum plate buckling coefficient for simply supported column) and psi-min (where psi-min is the adjusted plate side ratio for simply supported column corresponding to K-min for m, the number of half waves of buckled column in longitudinal direction, equal to unity) for a given material and section The parameter psi-min for a given cross section was found to be constant for all orthotropic materials A A

A79-33586 Ultrasonic bonding arrives - 75% cost savings seen J Devine and R G Vollmer (U S Army, Aviation Research and Development Command, St Louis, Mo) *ManTech Journal,* vol 3, no 1, 1978, p 11-14

Current and projected applications of ultrasonic bonding are described Demonstration tests on access doors for advanced attack helicopters are considered, noting that the results have consistently demonstrated energy savings per spot bond up to 90% Applications in the areas of extrusion, pultrusion, and machining, as well as on prototype doors for the B-1 avionics bay are also considered Expected applications in electronics industry are mentioned A A

A79-33587 Composites tooling speeds fabrication - Energy, labor cost cut sharply B M Halpin, Jr (U S Army, Materials and Mechanics Research Center, Watertown, Mass) and G A Gorline (U S Army, Aviation Research and Development Command, St Louis, Mo) *ManTech Journal,* vol 3, no 1, 1978, p 15-17

The hot layup-tooling technique providing significant cost reduction in the fabrication of helicopter components is discussed The operational characteristics of the process are described, as are experiments evaluating advantages over oven curing A summary of cost savings attributable to the technique is presented, and future plans calling for development of a single step cure are mentioned A A

A79-33588 Copter windshields made tougher - Special coating extends life, adds safety J R Plumer (U S Army, Materials and Mechanics Research Center, Watertown, Mass) *ManTech Journal,* vol 3, no 1, 1978, p 18-20

A U S Army research study leading to the development of a coated polycarbonate windshield design which eliminates such problems as transparency loss and spalling is discussed The design is compared with standard acrylic windshields, noting that it has demonstrated a service life about four times greater than its counterparts Initial tests conducted at Army's Materials and Mechanics Research Center are considered A table indicating evaluation results on the performance of polycarbonates, hard coatings, acrylics, and glass cladding materials is presented A A

A79-33589 NC equipment spurs blisk manufacture - Full-scale production slated F H Reed (U S Army, Aviation Research and Development Command, St Louis, Mo) *ManTech Journal,* vol 3, no 1, 1978, p 24 27

A newly developed automated process for the manufacture of blisks and impellers for helicopter engine compressors is discussed Studies conducted in the 60s to define a new transport helicopter with advanced airframe and engine design are taken into account The program for developing a multiaxis multispindle numerical control milling technique for producing blisk and impeller airfoils is described, together with a review of the airfoil forming operation The future status of the technique is noted A A

A79-33590 Erosion resistant clad rotor blades - Boride coatings do the job G A Gorline (U S Army Aviation Research and Development Command, St Louis, Mo) and A R Stetson (Solar Turbines International, San Diego, Calif) *ManTech Journal,* vol 3, no 1, 1978, p 28-32

Erosion of rotor blade leading edges has been found to be a major problem when helicopters operate in heavy rains or in continually dusty and sandy conditions Recently developed coating methods expected to eliminate the problem are discussed Results of tests with boride coatings on 410 stainless steel and 17 4PH alloys are examined, showing that the process improved the base alloy dust erosion resistance by 20 times A recent test comparing coated alloys with the currently used chromium plate is described, as are investigations on the influence of strain in the coating on the dust erosion resistance Technologies needed to utilize the advantages of boride coatings are mentioned A A

A79-33591 Fewer controls, easier inspection - Diffusion bonding shows cost advantages J J Lucas and M J Bonassar (United Technologies Corp , Sikorsky Aircraft Div , Stratford, Conn) *ManTech Journal,* vol 3, no 1, 1978, p 35-39

Diffusion bonding to be used as an alternate process for fabricating Ti 6Al-4V main rotor blade spars for the UH 60A Black Hawk helicopter is discussed The advantages of the technique over plasma-arc welding are described, showing that it does not require inert atmosphere and numerous process controls, and the diffusion bonded joints are easier to inspect than the countered and irregularly shaped weld beads The operational characteristics of the technique

are considered, as are configuration and function of the preform shape used in process development Process parameters and the selection of design tools are noted A A

A79-33600 # **Economical processing for the fabrication of CFRP components (Wirtschaftliche Fertigungsmethode fur den Bau von CFK-Strukturbauteilen)** D Benz, K Hutterer, and S Roth (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Symposium uber wirtschaftliche Herstelltechniken, Cologne, West Germany, Mar 28, 1979, Paper 79-009* 52 p In German

The economical aspect of the current processing concept for CFRP components is examined by comparing cost data for wing flaps and horizontal tail assemblies using CFRP reinforcements with those using metal reinforcements In the case of wing flaps the cost factor for the fiber version was found to be 1 4 higher than for the metal version With regard to horizontal tail assemblies, the estimated costs for the fiber version were shown to be between 1 27 and 1 55 higher A A

A79-33605 Conflict alert for the air traffic control system G Rowland (FAA, Washington, D C) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 30-33

The conflict alert function warns controllers when aircraft are on converging courses which may lead to a violation of safe separation distances The ATC system is briefly described with emphasis on operational/environmental differences between the 20 Air Route Traffic Control Centers and the 63 Automated Radar Terminal Systems Conflict alert functions are described in terms of design and aircraft eligibility requirements B J

A79-33606 Beacon-based collision avoidance system - Experimental results T E Morgan, Jr and B R Billmann (Computer Sciences Corp , Atlantic City, N J) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 34-38 8 refs

The paper provides an example of the use of the National Aviation Facilities Experimental Center's (NAFEC) Air Traffic Control Simulation Facility (ATCSF) This real-time simulation laboratory was used in experimental work in support of the Beacon-Based Collision Avoidance System (BCAS), one of several aircraft separation assurance programs being evaluated by the FAA Important results of the experimentation include the development of a pilot collision avoidance command response model, the identification of collision resolution logic errors, the reshaping of the threat region to reduce the rate of unnecessary alarms, and the determination that BCAS logic provides adequate pairwise conflict resolution in a terminal area (Author)

A79-33607 Factors in evaluating the effectiveness of a collision avoidance logic D L Roberts (Mitre Corp , Metrek Div , McLean, Va) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8 12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 39-42

A technique for the computer simulation analysis of a collision avoidance systems (CAS) is described A Monte Carlo simulation program is described in terms of the simulated flight environment (including error models of various system parameters) and its interface with the CAS logic to be evaluated This technique is applied to 14 actual midair collisions which were recreated from NTSB accident investigation reports B J

A79-33608 Threat logic for air-derived CAS B Hulland (Hulland Engineering, Melville, N Y) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 43-46

The threat logic concept for the BCAS (Beacon Collision Avoidance System) under development is described The BCAS threat logic is designed to resolve conflicts in a high density air traffic environment without creating secondary conflicts A major design goal was to produce a logic that would build pilot confidence when in visual conditions by selecting maneuvers that correspond as nearly as possible to what the pilot would select Another major goal was to minimize any conflict of BCAS with the ATC system The paper describes the logical structure and algorithms employed in the BCAS threat logic As background for the discussion of the threat logic, a brief description of the overall BCAS system is included (Author)

A79-33609 Aircrew experiences in USAF ejections, 1971-1977 W D Harrison (USAF, Inspection and Safety Center, Norton AFB, Calif), In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8 12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 47-51

Since October 1949, over 4,400 USAF aircrews have abandoned their aircraft using an explosive ejection system The types of ejection cover a small variety of systems, such as ballistic, rocket, and encapsulated seats, and aircraft modules Unfortunately, regardless of the improvements in ejection hardware, our success rate has not improved appreciably During the 7 years that this report covers, the Air Force has experienced a success rate of 82 percent, matching our 28-year historical mean In successful ejections, injuries have also remained at a high level, with 22 percent being major and 37 percent being of a lesser degree A parachuting aircrew can be forced to land anywhere, but usually is faced with three basic possibilities an open-field parachute landing fall, a drop into the trees, or a water landing In earlier years, survivors encountered many hazardous circumstances, spending many hours, and even days, awaiting pickup Now, 97 percent of ejectees are rescued within 4 hours, and 58 percent are picked up within the first 60 minutes following ejection (Author)

A79-33610 Mechanism of extremity injuries occurring during ejection from F-4 aircraft. S P Combs (USAF, Aerospace Medical Research Laboratories, Wright-Patterson AFB, Ohio) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8 12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 52-55

A retrospective study of F-4 ejections for 1967-1977 revealed extremity injuries during the ejection sequence in 43 of 399 ejections for an injury rate of 10 8% The majority of severe upper extremity injuries involved the proximal joints and the majority of the severe lower extremity injuries involved the distal joints When the windblast/windflail injuries were compared to the various variables, correlation was seen with the knots indicated airspeed (KIAS), aircraft attitude, and aircraft type B J

A79-33611 Aviation emergency procedures J X Stefanki (Air Line Pilots Association, Washington, D C) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 56-60

Aircraft and airport emergency requirements are discussed from the point of view of the airline pilot, with emphasis placed on emergency evacuation procedures It is concluded that aircraft and airport personnel and surrounding communities need annual compulsory simulated airport emergency training exercises for airport certification in order to upgrade their ability to handle any medical mass emergency situation B J

A79-33612 CFR Vehicle design and performance objectives. R Mitchell (Walter Motor Truck Co , Voorheesville, N Y) In Survival and Flight Equipment Association, Annual Symposium,

16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 61-67

Tables of design and performance requirements for CFR (crash fire rescue) vehicles are presented These vehicles must be capable of delivering fire fighting agent and personnel to the scene of an accident within the practical limits of a given airport, this would require quick response over improved and unimproved terrain, making the vehicle's off-road ability and acceleration critical Particular consideration is given to the design and performance of a quick response or rapid intervention vehicle which would be necessary for fighting a holding action pending the arrival of major fire fighting vehicles . B J

A79-33613 An overview of the U S Navy Maximum Performance Ejection System J J Tyburski (U S Naval Material Command, Naval Air Development Center, Warminster, Pa) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 71-74

The Maximum Performance Ejection System (MPES) program was initiated in 1969 in order to address various problems associated with escape systems in high performance and V/STOL type aircraft The present paper is an overview of the various state-of the-art technology advances employed by MPES in order to attain superior escape performance during adverse altitude and inverted conditions at altitudes as low as 50 feet Consideration is given to basic seat structure, restraint, recovery, propulsion and control, and survival subsystems B J

A79-33614 Feasibility demonstration of a vertical seeking seat steering system W J Stone (U S Naval Weapons Center, China Lake, Calif) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8 12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 75-78

The design, fabrication, and testing of a steering and autopilot system for an aircrew escape seat are described The seat steering system consists of a two-axis gimbaled spherical rocket motor, hydraulic actuators, servovalves, and hydraulic power supply The autopilot uses a three-axis strapdown rate gyro sensor package and microprocessor Three seat flight tests demonstrating the capability of the system to steer the escape seat into a vertical-seeking trajectory from adverse aircraft attitude ejections are described B J

A79-33615 Vertical-seeking autopilot design R G Stoutmeyer (U S Naval Weapons Center, China Lake, Calif) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings
Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 79-82

The concept of a vertical seeking, thrust vector controlled ejection seat requires sophisticated yet inexpensive electronic control hardware (an autopilot) to guide the seat to an upright posture irrespective of initial attitude A simplified strap-down inertial sensing system configured around the 8080 A Industrial Standard Microprocessor was chosen This mating of aerospace guidance technology and the semiconductor industry's large-scale integration digital processor technology resulted in a highly successful, low-cost seat controller/sequencer with software flexibility A review of the electronic hardware and software algorithms, with salient features of each, is presented (Author)

A79-33616 Development of hermetically sealed low-maintenance high-density packaging for ejection seat-mounted personnel parachutes G R Drew (U S Navy, National Parachute Test Range, El Centro, Calif) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 83-86

A79-33617 Aerodynamic effects simulator F E Gerber and W J Hock, III (Dayton T Brown, Inc , Bohemia, N Y) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 87-90

An aerodynamic simulator which would complement sled and flight testing of aircraft escape systems is proposed The simulator design makes use of an existing windblast facility, and includes an airflow generator capable of producing an airstream velocity up to 600 knots, as well as instrumentation to record ejection seat velocity and acceleration and canopy separation and trajectory Problems in attaining a uniform airflow from the six by ten ft generator nozzle are discussed J M B

A79-33618 Development and initial test results of parachutes with Automatic Inflation Modulation /A I M / D B Webb (Irvin Industries Canada, Ltd , Fort Erie, Ontario, Canada) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8 12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 106-112

The Automatic Inflation Modulation program for the development of improvements in the control of emergency escape personnel parachute opening in order to produce the fastest possible opening consistent with human tolerances is presented Improvements consist of the use of unidirectional stretch fabrics in the crown of the parachute to provide the canopy with a variable permeability governed by the dynamic pressure applied, thus allowing opening time to depend directly on the deployment speed, with an extension of the deployment speed envelope The use of a small auxiliary parachute within the main canopy (Webb chute) is intended to provide forced symmetrical and consistent canopy opening Current development work is concerned with investigating the performance limits of the proposed concepts and the development of a new canopy design It is concluded that the proposed improvements are capable of alterations to parachute opening timing and loading in the manner required to improve parachute recovery distance A L W

A79-33619 Basis for an objective evaluation of the paratroop jumping reliability J Rousseau (Aerazur, S A , Issy-les-Moulineaux, Hauts-de-Seine, France) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8 12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 113-116

The paper describes a parachute evaluation procedure in which a range of jump parameters is specified which characterize a successful jump An analytical model for predicting jump reliability is proposed, taking into account at least 23 random variables P T H

A79-33620 Milestones in the history of parachute development D Gold (Irvin Industries, Inc , Stanford, Conn) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings
Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 117-122

The first successful pack-on-body parachute was developed at the beginning of the 20th century, but it was not until the era of the Second World War that a number of technical advances based on aerodynamic principles were introduced into parachute design Ribbon parachutes and extremely stable solid (guide-surface type) parachutes were produced at this time The advent of aircraft capable of speeds in the Mach 1 0 3 0 range led to the use of conical ribbon parachutes with built-in multi porosity geometries Extended skirt parachutes and pressure packing techniques also receive attention J M B

A79-33622 Ejection systems in the year 2000 A B McDonald (Douglas Aircraft Co , Long Beach, Calif) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings

Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 130-134

This paper describes aircrew ejection systems which will be available in the year 2000 The scope of system development which can be expected is defined by reference to the rate of innovation that has occurred in the last 20 years Factors which govern development are discussed and areas where future improvements would be desirable are described Future trends in aircraft development are projected to identify possible new ejection system requirements Ejection system technology is discussed with regard to the potential developments that would permit significant advances in the state of the art On the basis of the projected requirements and expected technology advances, potential design innovations are described These include developments in inflatable structures, microelectronics, and ballistic subsystems that could result in significant improvements in capability relative to current systems (Author)

A79-33623 **U S Navy developments in crashworthy seating** L P Domzalski, M E Katzeff, and J T Micciche (U S Naval Material Command, Naval Air Development Center, Warminster, Pa) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 135-143 24 refs

The Naval Air Development Center has conducted various RDT&E programs in the areas of crashworthy armored/unarmored pilot/copilot seats, energy attenuation, advanced restraint system, and crashworthy troop, gunner, and military passenger seats The present paper reviews some of the significant crashworthy fixed-seating programs conducted by the Navy Consideration is given to the energy attenuator programs, the CH-46E crashworthy crewman seat, the joint Army/Navy standardized crewman seat, the crashworthy unarmored crewman seat, and the crashworthy gunner/crew chief seat B J

A79-33624 **Inflatable survival systems for helicopters** E J Colacicco (U S Naval Material Command, Naval Air Development Center, Warminster, Pa) and M Sloane (Sanders and Thomas, Inc , Pottstown, Pa) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 144-149

A review of the accounts concerning water ditchings of helicopter aircraft indicates that a number of lives may potentially be saved by the introduction of one of several new supplementary inflatable systems Since a number of victims had insufficient time to egress from their downed aircraft prior to its rapid inversion and sinking, one corrective approach discussed involves the use of a helicopter flotation-stability system for preventing inversion and sinking Another program development presented is one whereby personnel life rafts are stowed external to the aircraft and are automatically expelled upon contact with water This system would replace the current inboard stowage of rafts and would aid that survivor who succeeds in escaping the aircraft but who does not have sufficient time to avail himself of liferaft flotation as now provided (Author)

A79-33626 * **Helicopter emergency escape** L J Bement (NASA, Langley Research Center, Hampton, Va) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 155-164

The three-man Rotor Systems Research Aircraft (RSRA) Emergency Escape System, the first system known to be fully qualified and operational in a rotary wing aircraft, will have two modes of operation one providing for full in flight egress, and the other for the severance of the rotor blades for a return to base as a fixed-wing aircraft This paper describes the escape system's design principles, integration into the aircraft, qualification, and performance (Author)

A79-33630 **Detection of CAT and low altitude wind shear by on-board aircraft IR sensors - An update** P M Kuhn (NOAA, Atmospheric Physics and Chemistry Laboratory, Boulder, Colo) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 181 184

In-flight testing on NASA jet aircraft has been carried out for a NOAA infrared system designed to provide clear air turbulence and low-altitude wind shear alerts Clear air turbulence encounters were forecast 80% of the time on board the C-141-A, and 86% of the time on board the NASA Learjet False alarm rates were 10% and 25%, respectively J M B

A79-33635 **Development and testing of a dual mode escape propulsion system** D M Sorges (U S Naval Weapons Center, China Lake, Calif) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 250-253

This paper describes the development and feasibility testing of a Dual Mode Escape Propulsion System (DMEPS) applicable to ejection seats utilizing a pneumatically-actuated underseat motor DMEPS is specifically designed to expand the safe ejection envelope for inverted or near inverted ejections DMEPS consists of two major subsystems - an electronic unit which monitors aircraft attitude, and an interrupter system mounted on the ejection seat which selectively prevents ignition of the underseat motor based on data supplied by the electronic unit (Author)

A79-33636 **Unique crew escape concepts for ATS mission aircraft.** D E Swanson and V K Rajpaul (Boeing Aerospace Co , Seattle, Wash) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8 12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 254-257

An investigation into the critical environments and problems associated with escape from a high performance aircraft led to some of the new ideas for crew escape from these aircraft These were screened and combined resulting in five concepts for comparison within a tradeoff study The concepts were then configured as basic functional elements in a crew escape system within the framework of a combat aircraft with ATS (air-to-surface) mission A tradeoff study compared each scheme in terms of escape capability (Mach 3, 80,000 ft altitude, 2000 psf dynamic pressure, 6-10 g), airframe integration, cost, weight, reliability, maintainability, development risk and impact on rescue and survival operations Three schemes show potential for providing escape in the specified environment These are the separable forebody, the optional ejection direction, and the retained windshield/aftbody streamline configurations (Author)

A79-33637 **An experimental passive microwave attitude measurement system for escape system steering.** J O Hooper and B Heylauff (U S Naval Weapons Center, China Lake, Calif) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 258-261

Previous design studies including closed loop digital simulation have led to a baseline design for a microwave radiometric (MICRAD) attitude reference system (MARS) for pilot escape systems steering An experimental MICRAD attitude reference measurement system (MARMS) has been designed, fabricated, and tested A data collection mission in an operational environment has been carried out (June 14, 1978) aboard a thrust vector-controlled vertically seeking pilot escape system The MARMS atop the rocket powered escape system was fired toward the nadir from an altitude of 100 feet The MARMS performed throughout the vertically seeking trajectory, however, much of the MICRAD signal data was biased outside of the dynamic range of the telemetry channels Planned data

collection on the ground in a control environment and operational flight data will be used to further test system concepts and lead to the design of experimental MARS for a free flight guidance demonstration (Author)

A79-33639 High strength stitching for aircraft personnel restraint systems L Farris (Pacific Scientific Co , Anaheim, Calif) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 273 275

A79-33640 Death by misadventure W L Traynor (Stencel Aero Engineering Corp , Asheville, N C) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8 12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 276-281 6 refs

Studies sponsored by US military services have shown that 40 to 60% of the fatalities due to helicopter crashes could be prevented by in-flight escape systems In this paper a reliable, cost-effective in-flight escape system which can be adapted to several types of helicopters is described Problems related to blade and canopy severance also receive attention In addition, the inadequacy of autorotation for preventing helicopter accidents is mentioned J M B

A79-33644 Anatomy of an aircraft accident R E Engel In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8-12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 303, 304

A Continental Airlines DC-10 taking off from Los Angeles International Airport blew out two tires, causing the pilot to abort the takeoff As the aircraft went off the runway, the left main gear collapsed, rupturing two fuel tanks The spilled fuel ignited at once Prompt arrival of a fire-fighting team and a high application (more than 3000 gal per min) of extinguishing agents led to rapid control of the fire As a result of fire-fighting efficiency and good emergency procedures at the site, only three of the 197 people on board the aircraft lost their lives J M B

A79-33646 On the status of experimental stress analysis of parachute canopies H G Heinrich (Minnesota, University, Minneapolis, Minn) In Survival and Flight Equipment Association, Annual Symposium, 16th, San Diego, Calif , October 8 12, 1978, Proceedings Canoga Park, Calif , Survival and Flight Equipment Association, 1979, p 315-321 19 refs Research supported by the University of Minnesota, Contracts No F33615-68-C-1227, No F33615-73-R-3149, No F33615 C-0020

A sensor for measuring stress in parachute canopies and other flexible structures was developed Its sensing elements are a curved metal beam and electric strain gages To avoid transfer of bending moments from nonrigid surfaces to the sensor, the ends of the curved beam are glued to the structure by means of cloth tabs Because of its shape the sensor is called omega sensor Under the open side of the beam the cloth is slotted and the stress in the surface is transfered across the slot by the sensor Therefore, the omega sensor measures the stress independent of the strain of the material (Author)

A79-33827 Very Large Vehicle Conference, Arlington, Va , April 26, 27, 1979, Technical Papers Conference sponsored by the American Institute of Aeronautics and Astronautics New York, American Institute of Aeronautics and Astronautics, Inc , 1979 133 p $10 00

Papers are presented on the demand for large freighter aircraft as projected by NASA cargo/logistics airlift system studies, large wing-in-ground effect transport aircraft, and nuclear aircraft innovations and applications Consideration is also given to large lighter-than-air vehicles, the concept of a large multimission amphibian aircraft, and strategic airlift vehicle concepts B J

A79-33828 # Analyzing technology potential for strategic airlift S L Brown (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and G A Pasquet (USAF, Military Aircraft Command, Scott AFB, Ill) In Very Large Vehicle Conference, Arlington, Va , April 26, 27, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 1 7 7 refs (AIAA 79-0841)

In the time required to develop and demonstrate a technology, an operational scenario may change, with a possible change in flight vehicle requirements To resolve this dilemma, the AFFDL is sponsoring exploratory programs to analyze the relation between technology performance and military effectiveness A current laboratory goal is identification of technologies that enhance the airlift mission while being relatively insensitive to scenario changes In these analyses the aircraft is considered as one element in a total dynamic mobility system To understand aircraft technology contributions, the variables of time, productivity, airfield characteristics, and military effectiveness are considered (Author)

A79-33829 * # Demand for large freighter aircraft as projected by the NASA cargo/logistics airlift systems studies A H Whitehead, Jr (NASA, Langley Research Center, Aeronautical Systems Div , Hampton, Va) and W H Kuhlman (McDonnell Douglas Corp , Long Beach, Calif) In Very Large Vehicle Conference, Arlington, Va , April 26, 27, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 8-18 7 refs (AIAA 79 0842)

This paper examines the market conditions up through the year 2008 to provide a preliminary assessment of the potential for and the characteristics of an advanced, all-cargo transport aircraft Any new freighter must compete with current wide-body aircraft and their derivatives Aircraft larger than the wide-bodies may incur economic penalties and operational problems A lower direct operating cost is not a sufficient criterion to base a decision for the initiation of a new aircraft development or to select aircraft characteristics Other factors of equal importance that are reviewed in this paper include considerations of the system infrastructure, the economics of the airlines, and the aircraft manufacturer return on investment The results of the market forecast and a computer simulation show that an advanced long range aircraft with a payload between 68 to 181 tonnes (75 to 200 tons) could generate a solid foothold beginning around 1994 (Author)

A79-33830 # Large wing-in-ground effect transport aircraft R H Lange and J W Moore (Lockheed Georgia Co , Marietta, Ga) In Very Large Vehicle Conference, Arlington, Va , April 26, 27, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 19-29 16 refs (AIAA 79-0845)

The paper presents results of preliminary design studies of large wing-in-ground (WIG) effect transports utilizing a power-augmented ram (PAR) system for lift enhancement These studies include span-loader and fuselage-loader designs and cover gross weights up to 1 9 million lbs and payloads up to 661,500 lbs It is found that the PAR/WIG transport aircraft shows relatively low operating empty and gross weights and only slightly lower cruise fuel efficiency than a high subsonic speed land-based conventional advanced technology transport B J

A79-33831 * # Large lighter-than-air vehicles N J Mayer (NASA, Washington, D C) In Very Large Vehicle Conference, Arlington, Va , April 26, 27, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 45-52 13 refs (AIAA 79-0847)

The background of experience and the results achieved in building large airships are discussed Two current applications are identified These are in heavy vertical lift and in long endurance patrol

The most promising concepts for these missions include hybrid combinations of helicopters and aerostats and more conventional rigid types These new approaches will require some technology development in aerodynamics and structures, but all vehicles will benefit from application of modern methods and materials (Author)

A79-33832 * # **Concept for a large multi-mission amphibian aircraft** J C Vaughan, III (NASA, Langley Research Center, Hampton, Va) and T D Earl (Bell Aerospace Textron, Buffalo, N Y) In Very Large Vehicle Conference, Arlington, Va , April 26, 27, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 53-61 8 refs (AIAA 79-0849)

A very large aircraft has been proposed for meeting both civil cargo and military transport needs for 1995 and beyond The concept includes a wide noncircular fuselage cross section with a low wing, thick inner wing section, fuselage-mounted engines, and an air cushion landing gear The civil freighter operates independently of congested passenger airports, using sheltered water as a runway and a waterfront land site for parking and ground operations The military transport can operate from a wide variety of surfaces and temporary bases The air cushion landing gear weighs substantially less than conventional gear and permits the use of extended takeoff distance resulting in improved payload/gross weight ratio B J

A79-33833 # **Strategic airlift vehicle concepts** F C Newton (McDonnell Douglas Corp , Long Beach, Calif) In Very Large Vehicle Conference, Arlington, Va , April 26, 27, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 62 66 (AIAA 79 0850)

A study is reported whose object was the definition of future strategic airlift vehicle concept options and the technologies required for successful operational implementation for the year 2000 and beyond The definitions include vehicle characteristics, operational features, and figures of merit reflecting the relative effectiveness and cost implications of the options The primary conclusion is that the distributed-load configuration concept offers an attractive technology option for the strategic airlift mission Not only does this concept exhibit the lowest life cycle cost and acquisition cost, but also the best vehicle size is relatively insensitive to the scenario assumptions B J

A79-33834 * # **Technology requirements and readiness fc. very large vehicles** D W Conner (NASA, Langley Research Center, Systems Analysis Branch, Hampton, Va) In Very Large Vehicle Conference, Arlington, Va , April 26, 27, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 67-75 (AIAA 79-0851)

Common concerns of very large vehicles (VLV) in the areas of economics, transportation system interfaces, and operational problems are reviewed with respect to the influence of these factors on aircraft configurations and technolgoy Fifty four technology requirements for VLVs have been identified and rated with regard to technology readiness The requirements were about equally divided among the four general areas of aero/hydrodynamics, propulsion and acoustics, structures, and vehicle systems and operations None of the requirements were considered to have an excellent technology readiness B J

A79-33835 # **Advanced nuclear systems for large aircraft** J P Layton In Very Large Vehicle Conference, Arlington, Va , April 26, 27, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 76-130 19 refs (AIAA 79-0852)

Recent advances in nuclear power and propulsion systems as well as aircraft technology have resulted in large military aircraft concepts that promise practical operational aircraft An approach to the interdependent definition of future military missions and credible nuclear aircraft based on a carefully conceived program of analysis, research, and technology is outlined Particular consideration is given to advanced nuclear aircraft concepts, including heavier-than-air and lighter than-air Aspects of operational safety are emphasized B J

A79-34305 **A new high product rate 10 nanosecond, 256 point correlator** K H Norsworthy (Boeing Aerospace Co , Seattle, Wash) *Physica Scripta*, vol 19, Apr 1979, p 369-378 6 refs

The design philosophy and performance characteristics of a new high product-rate correlator developed for weapon systems applications and fluid mechanics research are described The design approach provides versatility for time sharing 30 1-bit multipliers between 256 correlation processing channels with the full speed of the multipliers (12 5 MHz) being utilized irrespective of the magnitude of the delay increment selected The correlator can either accept digitized pulsed signals (LDV applications) or continuous analog voltages and can be set to operate in either a double-clipped, double-linear, or single linear mode of operation Microprocessor-controlled output circuitry provides a convenient display format and the capability for Fourier transformation of the computer correlation function B J

A79-34314 **Preliminary studies using photon correlation velocimetry in turbomachinery and combustion systems** R S Adrain, R C Klewe, D G Wright (Central Electricity Generating Board, Marchwood Engineering Laboratories, Southampton, England), R L Elder (Cranfield Institute of Technology, Cranfield, Beds , England), P H Richards, and G D Smith (Cambridge University, Cambridge, England) *Physica Scripta*, vol 19, Apr 1979, p 441-446 6 refs

This paper combines three presentations to the conference on 'Photon Correlation Techniques in Fluid Mechanics' It describes preliminary results of velocity and turbulence measurements from experiments designed to tackle the constraints imposed by large scale engineering devices Two of the papers deal with turbomachinery and the third with a small combustion system Measurements in an axial compressor are described which compare the performance of a two-spot laser system with that of an angled hot wire and concentrates on the development of the wake region as the flow moves downstream Also a Doppler fringe system is used to obtain velocity profiles in the diffuser section of a centrifugal impeller The data presented was obtained mainly at an operational speed of 30,000 rpm but some results are given for a speed of 60,000 rpm Different problems are encountered with combustion systems and these are discussed with reference to measurements on small industrial burner (Author)

A79-34392 **Experimental analysis of V H F antennas for helicopter homing systems using scale-model techniques** M S Smith (Royal Aircraft Establishment, Farnborough, Hants , England) *Radio and Electronic Engineer*, vol 49, Apr 1979, p 197-203 5 refs

A typical requirement in azimuthal antenna systems operating in frequency bands between 30 and 400 MHz is to enable the pilot to home on to a ground transmission The use of scale modeling for assessment of helicopter homing systems, including appropriate measurements techniques for 800-1050 MHz and 180-450 MHz frequency bands, is described Three different homing applications, left-right homing at 135-175 MHz, left-right homing at 30-75 MHz, and fore-aft homing at 135-175 MHz, are examined, demonstrating the importance of the antennas' interaction with the aircraft's metal fuselage A A

A79 34470 Aircraft glassmaker J M Ramsden *Flight International*, vol 115, Apr 28, 1979, p 1302 1304

The article presents a brief profile of the British firm Triplex describing the selection of the firm as suppliers of windshields for the Boeing 767 and 747 aircraft Aircraft for which the Triplex became suppliers and contracts the firm did not succeed in receiving are also mentioned, in context with the sharpening of its technical and marketing efforts The construction and features of the 747 windshield are detailed The argument of flat versus curved glass is discussed and requirements for airworthiness and spin offs in other markets such as locomotive windows are mentioned M E P

A79-34504 # **Semiautomatic control of aircraft Systems of manual aircraft control (Poluavtomaticheskoe upravlenie samoletom Sistemy ruchnogo upravleniia samoletom)** V I Rudis Moscow, Izdatel'stvo Mashinostroenie, 1978 151 p 6 refs In Russian

The book is concerned with problems of manual flight control in all regimes, with particular reference to optimization of the man-machine interface Specifications of aircraft characteristics for manual control are indicated Attention is given to the relations between the aircraft design flexibility and the pass band of corrective automatic devices Methods of designing automatic devices for improving manual aircraft control are discussed S D

A79-34521 * # **Identification of a STOL propulsion plant model from flight data** R L De Hoff (Systems Control, Inc /VT/, Palo Alto, Calif) *Journal of Guidance and Control,* vol 2, May-June 1979, p 235 240 10 refs NASA Contract No 36074-13

Accurate dynamic models for propulsion system behavior are critical to successful synthesis of STOL autothrottle/autoland control systems This paper describes the development of a nonlinear dynamic model for the response of a STOL aircraft in the landing/approach configuration The model is based upon an analysis of the throttle, governor, and turbofan engine components Model parameters are directly identified from data acquired during a flight of the NASA Augmentor Wing Jet STOL research aircraft The accuracy of the model and a comparison of results for two engines are described Various approaches to modeling propulsion system response for complex systems representative of current and near-term aircraft are discussed (Author)

A79-34522 # **The role of the backside parameter in height control** K Kato (Tokyo, University, Tokyo, Japan), S Mihara, and H Nakamura *Journal of Guidance and Control,* vol 2, May-June 1979, p 241 246 10 refs

Height control in continuous gust fields is formulated as a stochastic regulator problem and the relation between mean square (ms) height error and the backside parameter is examined The following results are shown First, when the throttle loop is open, elevator alone ceases to be a reasonable control strategy when the backside parameter is negative The minimum achievable ms height error is essentially only a function of the backside parameter, ms error is zero when the backside parameter is positive, while it is inversely proportional to the absolute value of the backside parameter when it is negative For the landing approach, this holds true approximately, regardless of airplane type Second, when the throttle loop is closed, it is generally difficult to tightly control velocity and height simultaneously in conventional airplanes This is mainly because the thrust change available in control is quite limited, particularly in deceleration To realize tight control in height, the accuracy in velocity control must be relaxed and the backside parameter has to be properly large (Author)

A79-34531 # **Time-variant aerodynamics of oscillating airfoil surfaces in a supersonic flowfield** S Fleeter and R E Riffel (General Motors Corp , Detroit Diesel Allison Div , Indianapolis, Ind) *AIAA Journal,* vol 17, May 1979, p 465-470 8 refs

The results of an experimental study of the time-variant aerodynamics associated with harmonically oscillating single airfoil surfaces in a supersonic flowfield are presented Six single airfoil configurations were investigated a flat plate, wedge, flat plate-convex corner, wedge-convex corner, MCA suction surface, and MCA pressure surface The basic time-variant aerodynamic data obtained for each of these configurations included the chordwise distribution of the unsteady pressure magnitude (expressed as an unsteady pressure coefficient) and its phase lag as referenced to the airfoil motion, with Mach number as parameter All of the data obtained are correlated with a low reduced frequency prediction which includes the effects of airfoil camber and thickness distribution (Author)

A79-34534 # **Unsteady pressure measurements on rotor blade tips with incidence** H Triebstein (Deutsche Forschungs- und Versuchsanstalt fur Luft und Raumfahrt, Institut fur Aeroelastik, Gottingen, West Germany) *AIAA Journal,* vol 17, May 1979, p 514 518

Measurements of pressure distributions on a harmonically oscillating rotor blade wing in low subsonic speed are reported The measurements were carried out in the 3 x 3 m subsonic wind tunnel of the DFVLR in Gottingen Pressures were measured at five sections of the wing in such a way that the three-dimensionality of the pressure distribution could be well observed The flow speed was 45 m/sec The oscillation frequencies were 2, 4, and 6 Hz, with reduced frequencies of 0 07, 0 14, and 0 21 The oscillation amplitudes ranged from B = 1-3 deg, and the angles of attack were 0, 3, 6, 9, and 12 deg Comparisons with theoretical and experimental results were made The analytic predictions were found to agree well with the measured data At the wing tip, however, the agreement was not uniform A brief description of the test facilities is also presented (Author)

A79-34537 * # **Peak Strouhal frequency of subsonic jet noise as a function of Reynolds number** K Yamamoto (New York, State University, Buffalo, N Y) and R E A Arndt (Minnesota, University, Minneapolis, Minn) *AIAA Journal,* vol 17, May 1979, p 529 531 9 refs USAF supported research, Grant No NGR-39 009-270

The narrowband spectral characteristics of the acoustic field generated by subsonic jets at low Reynolds numbers were studied in terms of a dimensionless power spectral density It was found that the variation of the sound magnitude of the spectrum is an increasing function of the Reynolds number The maximum level of the spectrum is not a linear function of the Reynolds number The spectra are insensitive to Reynolds number above a critical value of about 100,000 Up to Reynolds number of this magnitude, the peak Strouhal frequency observed at 30 deg emission angle is identical with that at 90 deg for any exit Mach number At higher Reynolds number the peak Strouhal number increases with increasing emission angle The peak Strouhal number was found to be about 0 2, which is in agreement with previous findings that a few discrete modes at a Strouhal number of around 0 2 in low Reynolds number supersonic jets are powerful noise generators P T H

A79-34539 * # **Asymmetry of a circular jet observed in near and far fields** K Yamamoto (New York, State University, Buffalo, N Y) and R E A Arndt (Minnesota, University, Minneapolis, Minn) *AIAA Journal,* vol 17, May 1979, p 533-535 NASA USAF-supported research

Turbulence intensity measurements were made in three different-size jets at various Mach numbers and the aerodynamic jet axis, defined as the locus of points in the flow at which the turbulence intensity is minimum, was determined The deviations from the geometrical jet axis were on the order of 2 4% of the nozzle diameter, and the pure jet axis had the form of a helical wave A similar asymmetry in the radiated noise was also noted The measured circumferential distribution of rms fluctuating velocity signals confirmed the asymmetry of even a circular jet P T H

A79-34550 **Formation of sooty particles in combustion chambers with series injection of air into the combustion zone** A G Tumanovskii (Vsesoiuznyi Teplotekhnicheskii Institut, Moscow, USSR) *(Teploenergetika,* vol 25, no 9, 1978, p 40-42) *Thermal Engineering,* vol 25, no 9, 1978, p 26-28 Translation

The health standards strictly limit the amount of smoke (soot) emission from gas turbine plants operating on liquid fuels For precise estimation of smoke formation in a combustion chamber, tests are performed using the procedure of collecting solid particles on special filtering surfaces by passing through them a calibrated sample of combustion products The sampling train consists of a tube for sampling, a unit with a filtering element, a flowmeter to measure gas flow through the filtering surface, and a thermometer The tests confirm that one of the efficient methods of reducing the concentration of sooty particles to an acceptable health standard level in high-heat-release-rate combustion chambers burning liquid fuels is the use of air-operated atomizers S D

A79-34580 **Traffic background level and signal duration effects on aircraft noise judgment.** G W Johnston and A A Haasz (Toronto, University, Downsview, Ontario, Canada) *Journal of Sound and Vibration,* vol 63, Apr 22, 1979, p 543 560 13 refs Research supported by the Ministry of Transport

The effects of background traffic noise level and signal duration on perceived aircraft noise levels during a flyover event are investigated Tapes of traffic noise at different levels on which aircraft flyover noise events of different durations were super imposed were played to groups of observers in a room simulating indoor conditions It is found that the presence of steady background traffic noise reduces the perceived noisiness of aircraft flyovers provided that the duration of the flyover event is sufficiently short in relation to flyover time For a given event level, a reduction of 21 dB(A) in background noise level leads to the perception of a 5 5 dB(A) increase in peak event level Regressions of observer response with the noise pollution index show a lower correlation than those with variables based on background noise level and peak signal level, although the data are found to exhibit a number of significant trends associated with noise pollution index variations A L W

A79-34585 **Relation between static and in-flight directivities of jet noise** A Michalke (Berlin, Technische Universitat, Berlin, West Germany) and U Michel (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Abteilung Turbulenzforschung, Berlin, West Germany) *Journal of Sound and Vibration,* vol 63, Apr 22, 1979, p 602-605

The effects of flight on the directivity of jet noise are predicted without recourse to a turbulence model The acoustic effect of flight is calculated by solving the convective Lighthill equation including jet temperature effects Theoretical results are compared with measurements of static and in-flight directivity on a line parallel to the jet path The predictions are shown to be in good agreement with the measurements, especially for emission angles of 90 deg to the jet axis, where existing theories fail It is noted that the formula derived provides only a lower limit to intensities in flight, due to disturbances in the nacelle boundary layer, which are not taken into account A L W

A79-34595 # **In-flight captive store loads compared with wind-tunnel and mathematical simulations** A R Maddox (U S Naval Weapons Center, China Lake, Calif), R E Dix, and G R Mattasits (ARO, Inc , Arnold Air Force Station, Tenn) *Journal of Aircraft,* vol 16, May 1979, p 289-295 8 refs

A series of flight tests were made to acquire captive loads data on a store to compare with corresponding data from several wind-tunnel tests, as well as with the best mathematical models when conditions were matched as closely as possible The store consisted of an Mk83 bomb shape mounted on a triple-ejector rack (TER) on an F-4 aircraft which was instrumented complete with a standard research boom mounted on the nose The flight conditions spanned Mach 0 6-0 9 in both maneuvering and steady flight Corresponding wind tunnel tests were made at 5% and 10% at specific research centers The data show good correlation between flight test and wind tunnel for moderate subsonic Mach numbers when good geometric similarity is maintained, but there is a pronounced divergence in this agreement as the Mach number is increased Correlation between mathematical models of this problem and the flight test show the same magnitude in loads and moments, but the trends do not always agree This is most pronounced in the pitch plane (Author)

A79-34596 # **Lifting surface approach to the estimation of gust response of finite wings** H Okubo (Osaka Prefecture, University, Sakai, Japan), M Kobayakawa, and H Maeda (Kyoto University, Kyoto, Japan) *Journal of Aircraft,* vol 16, May 1979, p 309-314 13 refs

Unsteady response of finite wings flying though turbulence is investigated using linearized lifting surface theory The NLR method, extended to the unsteady case, is employed for the numerical calculation of the lift force arising from oscillatory gusts for a wide range of frequencies An efficient numerical procedure is presented for the estimation of the response to random turbulence It takes into consideration the instantaneous variation of the vertical velocity of turbulence along the span as well as the spanwise distribution of the aerodynamic influence function This procedure uses the relation between the output power spectral density and the spanwise cross spectrum of turbulence, defined in terms of the spanwise correlated frequency response function, which in turn is derived from the aerodynamic transfer matrix for the modified upwash field The results computed by means of this method with a model of turbulence uniform in span, and with a model of isotropic turbulence, exhibit considerable differences Moreover the calculated lift spectrum is influenced by the spanwise load distribution which varies in shape according to the wing planform and the frequency of gusts (Author)

A79-34597 # **A computational scheme for structural influence coefficients of certain planar wings** J E Moore, Jr (USAF, Armament Laboratory, Eglin AFB, Fla) and M A Cutchins (Auburn University, Auburn, Ala) *Journal of Aircraft,* vol 16, May 1979, p 315-319 10 refs

The objective of this work has been to reduce the amount of numerical computation work involved in obtaining structural influence coefficients, especially for special purpose computer programs involving wings that have elastic axes that can be approximated by a series of straight line noncollinear segments The need for repetitive runs, probably due to different mass arrangements, enhances the desirability of the technique A general matrix of influence coefficients which allows the user to handle the N segmented case is derived and presented The decreased number of integral evaluations is summarized for a three segmented case as an illustration - only 12 integrals compared to 27 (straight), only 12 integrals compared to 42 (noncollinear) For collinear segments of practical wings, the order of required integral evaluations is shown to differ by N squared and by more for noncollinear cases Therefore, a significant reduction in computation effort is claimed (Author)

A79-34600 **F101 engine derivative work advances** W C Wetmore *Aviation Week and Space Technology,* vol 110, May 14, 1979, p 57, 59, 61

The F101-X fighter engine having a thrust-to-weight ratio of 7 5 1, to be flight tested in 1981, is discussed The structural design is considered, showing that the compressor disks are welded together to form a drum rotor, with fan pressure ratio being in excess of three and maximum airflow at about 270 lb/sec The ultraviolet sensor used as a light-off detector to inhibit high fuel flow rates is noted, as are the hydraulic actuators and the outer flaps and seals located in the exhaust nozzle The uncooled and tip-shrouded stages in the low pressure turbine ignition procedures, and the core fuel control are mentioned A A

A79-34604 **Response of plate to nonstationary random load** G Ahmadi and M A Satter (Pahlavi University, Shiraz, Iran) *Acoustical Society of America, Journal,* vol 65, Apr 1979, p 926-930 23 refs Research supported by the Ministry of Science and Higher Education and Atomic Energy Organization of Iran

The response of a rectangular plate subjected to nonstationary random load is studied The general expressions for the autocorrelation and the mean square displacement are derived and discussed Similar study was carried out for the stress components The random excitation is then assumed to be a modulated white noise or narrow-band process It is shown that when the damping coefficient is small, simple approximate expressions can be obtained for the variances of the lateral displacement as well as the stress components Several examples using a simply supported plate are presented (Author)

A79-34608 **The measurement of RF-pulse phase and amplitude in the landing system DLS (Die Messung von Phase und Amplitude an HF-Impulsen im Landesystem DLS)** E Vachenauer (Siemens AG, Munich, West Germany) *Frequenz*, vol 32, Apr 1979, p 113-117 In German Research supported by the Bundesministerium fur Forschung und Technologie

A method for determining aircraft flight direction, applied in the Landing System DLS is described Two ground stations, located at the runway, receive the RF-pulses from a landing aircraft with special antenna systems consisting of many individual antennas, and determine azimuth and elevation by measuring and evaluating the phase and amplitude distribution at the individual antennas The latter are connected to receivers with switchable amplifiers to allow the measurement of RF-pulse phase and amplitude over a dynamic range of 80 dB The measuring results are fed to a computer to determine the direction (Author)

A79-34650 # **Characteristics of Laval nozzles with gasdynamic regulation (Kharakteristiki sopel Lavalia s gazodinamicheskim regulirovaniem)** I S Varganov (Kievskoe Vysshee Voennoe Aviatsionnoe Inzhenernoe Uchilishche, Kiev, Ukrainian SSR) *Prikladnaia Mekhanika*, vol 15, Apr 1979, p 97 99 In Russian

Experimental data are presented on the thrust characteristics of Laval nozzles with gasdynamic regulation Particular consideration is given to the influence of nozzle underexpansion or overexpansion on the thrust coefficient B J

A79-34691 **On some methods for the numerical simulation of flows with complex structure** N N Ianenko, V M Kovenia, V D Liseikin, V M Fomin, and E V Vorozhtsov (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) *(Deutsche Forschungsgemeinschaft, International Conference on Finite Elements in Nonlinear Mechanics, Stuttgart, West Germany, Aug 30-Sept 1, 1978) Computer Methods in Applied Mechanics and Engineering*, vol 17 18, Mar 1979, p 659-671 18 refs

The paper considers the development of efficient difference schemes for application to compressible viscous heat conducting gas flows Particular consideration is given to the problem of shock wave localization in the numerical simulation of such flows The methods presented are essentially efficient in the computation of flows of complex structure, where singular zones and elements are present (e g , shock waves and transitions, contact strips, boundary layers, double and triple shock configurations, etc) B J

A79-34761 * # **Global services systems Space communication** F H Shepphird and H L Wolbers (McDonnell Douglas Astronautics Co , Huntington Beach, Calif) In Conference on Advanced Technology for Future Space Systems, Hampton, Va , May 8 10, 1979, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 519 525 10 refs Contract No NAS1 12346 NASA Task 28 (AIAA 79 0946)

The requirements projected to the year 2000 for space-based global service systems, including both personal communications and innovative services, are developed based on historic trends and anticipated worldwide demographic and economic growth patterns The growing demands appear to be best satisfied by developing larger, more sophisticated space systems in order to reduce the size, complexity, and expense of ground terminals The availability of low cost ground terminals will, in turn, further stimulate the generation of new services and new customers B J

A79-34823 **Britain's better airbus wing** D Velupillai *Flight International*, vol 115, May 5, 1979, p 1471, 1472

British Aerospace which produces the wings for the A 300 has been chosen to design and produce the wings for the new, shorter A 310 Competitive performance through significant aerodynamic and structural improvements is forecast, with such features of the wing as double curvature, outboard wing skin joints, and a two spar wing box detailed The double curvature design requires shot blasting which allowed placing of the span wise skin joints further outboard Because of the A 310's slightly smaller wing the center spar has been deleted allowing uninterrupted main ribs between the front and rear spars, eliminating additional joints and the need for two access covers Fuel wetted areas of the wing box will employ interference fit bolts Also under consideration is electrical signalling for the airbrakes and spoiler Carbon fiber reinforced plastic may be used for the airbrakes and leading edge shrouds instead of fiberglass M E P

A79-34824 **Weapons for the black-box war** D Richard son *Flight International*, vol 115, May 5, 1979, p 1476 1480, 1485-1488, 1493-1495

Techniques used to degrade and confuse radar defenses, allowing bombers and strike aircraft to avoid or blunt fighter or missile attacks are outlined NATO Band designations are presented and three broad categories of equipment are investigated, these being receivers, jammers and decoys Under receivers, IFF and RWR systems are covered Various levels of complexity are surveyed, the Thomson CSF-BK, Marconi ARI 18228, U S systems such as the APR 25RWR, APR 26 LWR and ALR 66 The Soviet Sirena series RWR is also highlighted as are anti-radar 'wild weasel' aircraft The section devoted to jammers discusses concepts such as spot noise, swept spot noise jamming, barrage jamming, range gate pull off, velocity and track breaking, inverse amplitude modulation and inverse gain jamming Chaff and its dispersal methods are covered in the Decoy section M E P

A79-34921 **Quieter short and medium haul aircraft** R E Pendley (Douglas Aircraft Co , Long Beach, Calif) *Airport Forum*, vol 9, Apr 1979, p 19, 20, 22 24 In English and German

The article details efforts by the aircraft industry to reduce aircraft noise levels Noise sources such as fan inlet, fan exhaust, turbine, jet core and airframe are discussed, showing how by pinpointing the different noise sources, it becomes easier to reduce each in turn, thereby effecting an overall noise reduction Diagrams illustrating graphically the relationship between engine noise and surrounding area are included The latest engine technology, which will be applied to the DC 9 Super 80 and includes large diameter fans and an internal mixer, is discussed Noise reduction can in turn mean a subsequent reduction in airport operating expense such as the need to purchase less surrounding real estate for a buffer zone M E P

A79-34922 **Four jets for short haul work BAe 146** J Lupson (British Aerospace Aircraft Group, Hatfield, Herts , England) *Airport Forum*, vol 9, Apr 1979, p 39, 40, 42, 43 In English and German

The article discusses the features of the BAe 146, a four engined short-haul aircraft, claimed to be quieter than today's twin engine models The aircraft has been designed to operate equally well from minimally developed fields as well as big international airports One of the important features is outstanding performance from 'hot and high' airfields The take-off field length of less than 1,500 m and good visibility are important at small airfields in difficult terrain A turning diameter of only 18 03 m, low sill heights, large passenger and access doors allow quick ground handling and servicing The aircraft also features an APU and GPU power points and pressure and gravity fueling points Ease of access, simplification of systems and handling, result in quick, 20 minutes turn-around M E P

A79-34923 **Preventing fires in airport fuel systems** L Scheichl *Airport Forum*, vol 9, Apr 1979, p 49, 50, 54 (3 ff) In English and German

This article examines the storage of aviation fuels in respect to fire prevention, discussing their physical properties and behavior in storage tanks Flash points, ignition temperatures, burning limits, etc are presented Discussion also includes protecting tank farms from fire and the various types fixed roof, fixed roof with floating ceiling, and floating roof tanks are dealt with Accomodating escaping vapors with vents and relief valves and precautions necessary when filling or draining tanks are also covered M E P

A79-34925 # **Measurement of ozone in an aircraft** S van Heusden (Philips' Gloeilampenfabrieken, Philips Research Laboratories, Eindhoven, Netherlands) and L G J Mans (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands) *Philips Technical Review*, vol 38, no 4 5, 1978 1979, p 131 134

Ozone levels were monitored outside and in the cabins of a jet aircraft making a scheduled flight between Europe and North America The measurements showed that 60 to 70% of the ozone present in the atmosphere was admitted to the cabins, as expected, the ozone level depended closely on aircraft altitude with respect to the tropopause It was found that ozone concentrations in the cabins exceeded the IATA limits of 80 to 100 ppb during most of the flight The medical effects of chronic exposure to elevated ozone concentrations are discussed J M B

A79-34971 **Perspectives on airport environmental compatibility, Proceedings of the Economic/Environmental Specialty Conference, Miami, Fla , March 2, 3, 1978** Conference sponsored by the Airport Operators Council International Washington, D C , Airport Operators Council International, 1978 243 p $20

The costs of airport noise control, the adoption of compatible land-use planning for airport vicinities, the consultant's role in developing airport noise control programs, and means of assessing airport noise are discussed Topics of the papers include the Environmental Noise Act adopted by Maryland, the integrated noise model proposed by the FAA for airport planning and land use control, the preventive airport noise control program developed by the Salt Lake City International Airport, and the recovery of expenses incurred in airport noise abatement J M B

A79-34972 # **Airport noise control and land use compatibility study** P B Gaines (Salt Lake City Airport Authority, Salt Lake City, Utah) In Perspectives on airport environmental compatibility, Proceedings of the Economic/Environmental Specialty Conference, Miami, Fla , March 2, 3, 1978 Washington, D C , Airport Operators Council International, 1978, p 27 44

Noise control and land use compatibility are not currently problems for the Salt Lake City International Airport, but planning has been initiated to guarantee that municipal or airport expansion does not lead to such problems in the future Preferential runway use, displaced runway thresholds, preferential approach and departure tracks, and specification of engine run up areas are among the means under consideration to control noise levels Zoning, building codes, easements, and taxing policies can be used by the municipalities to prevent incompatible land use J M B

A79-34973 # **A comparison of costs associated with local actions to reduce aircraft noise impacts** R H Doyle and J C Orman (Peat, Marwick, Mitchell and Co , San Francisco, Calif) In Perspectives on airport environmental compatibility, Proceedings of the Economic/Environmental Specialty Conference, Miami, Fla , March 2, 3, 1978 Washington, D C , Airport Operators Council International, 1978, p 45 101

Corrective and preventive measures to control airport noise are described, and the responsibility of the airport authority, the airlines, and the FAA in carrying out noise abatement actions is discussed Operational changes to control airport noise include extension of an existing runway, adoption of a computer program to modify noise exposure, alteration of aircraft maintenance procedures, imposition of curfews on aircraft operations, and establishment of greenbelt buffer areas around airports The acquisition of restricted-use easements and avigation easements, as well as the insulation of certain publicly owned buildings can contribute to airport noise reduction Master plans for airports and their environs, and the installation of noise monitoring systems are also mentioned J M B

A79-34974 # **Off-airport land use compatibility - The Maryland approach and experience** T J Truby (State Aviation Administration, Baltimore, Md) In Perspectives on airport environmental compatibility, Proceedings of the Economic/Environmental Specialty Conference, Miami, Fla , March 2, 3, 1978 Washington, D C , Airport Operators Council International, 1978, p 127-141

The Environmental Noise Act adopted by Maryland in 1974 provides for the minimization of the airport noise to which existing development is subjected, and prevents the introduction of new noise-sensitive development in the vicinity of airports The law mandates a noise control program for each of the public-use airports licensed by the state Local jurisdictions adopt airport noise regulations governing airports that are not state-owned, these regulations must be at least as stringent as the state code The limits established for cumulative noise exposure for various land-use categories are presented J M B

A79-34975 # **FAA proposes that the standard noise model be the integrated noise model /INM/** J Reynolds (FAA, Office of Airports Programs, Washington, D C) In Perspectives on airport environmental compatibility, Proceedings of the Economic/Environmental Specialty Conference, Miami, Fla , March 2, 3, 1978 Washington, D C , Airport Operators Council International, 1978, p 219-234

The latest version of the FAA integrated noise model (INM), released in 1978, is applicable to airport planning and land-use control The INM data base contains flight profiles and noise characteristics for most commercial airliners and a few general aviation aircraft Preparation of noise data for a medium hub airport with an average of 500 operations per day (50% jet aircraft) indicates that the model can furnish very economical contour studies and 1000-ft grid analyses The INM should prove useful in drawing up environmental impact statements for airport development plans J M B

A79-34978 # **Suppression of radio-electrical disturbances of electrostatic origin on aircraft (Elimination des perturbations radioelectriques d'origine electrostatique sur avions)** J L Boulay (ONERA, Châtillon sous-Bagneux, Hauts de-Seine, France) *La Recherche Aerospatiale*, Mar Apr 1979, p 89 108 24 refs In French Research supported by the Direction des Recherches, Etudes et Techniques

The paper reviews the main effects of accumulation of electrostatic charge on aircraft, presents some models for corona discharge and the antenna discharge coupling phenomenon, and examines some of the principal methods of suppressing radio electrical disturbances The mathematical demonstration by Tanner (1853) of coupling between an electric discharge and an antenna is reviewed and interpreted, and experimental methods of determining two key functions which appear in the analysis are presented The characteristics of orthogonal-decoupling dischargers and dischargers with multiple and independent discharges are studied, and types of antistatic protection of dielectric surfaces are defined P T H

A79-34980 # **Light propeller aircraft noise (Bruit des avions légers a helice)** C Dahan, L Avezard, G Guillien, C Malarmey, and J Chombard (ONERA, Châtillon sous Bagneux, Hauts-de-Seine, France) *La Recherche Aerospatiale*, Mar Apr 1979, p 129 137 9 refs In French

The acoustic field of a Rallye 235 aircraft was investigated by the microphone technique in conjunction with a model for predicting propeller noise The microphone measurements were complemented by flyover noise measurements by a technique which made it possible to avoid difficulties associated with the Doppler effect The calculation model was modified to take into account ground reflection, but although the model predicted well for the fly-away phase, the measured levels are higher than predicted for the approach phase It is concluded that further analysis should take into consideration 'thickness' noise and noise due to unsteady loading P T H

A79-34996 * # **Tests of NASA ceramic thermal barrier coating for gas turbine engines** C H Liebert (NASA, Lewis Research Center, Cleveland, Ohio) *American Vacuum Society and American Society for Metals, International Conference on Metallurgical Coatings, San Diego, Calif., Apr 23-27, 1979, Paper* 8 p 5 refs

A NASA ceramic thermal barrier coating (TBC) system was tested by industrial and governmental organizations for a variety of aeronautical marine, and ground based gas turbine engine applications This TBC is a two layer system with a bond coating of nickel-chromium aluminum-yttrium (Ni 16Cr-6Al 0 6Y, in wt %) and a ceramic coating of yttria stabilized zirconia (ZrO2-12Y2O3, in wt %) Tests (Liebert and Stenka, 1979) have been conducted to determine corrosion resistance, thermal protection, durability, thermal conductivity, and fatigue characteristics The information presented covers some of the significant test results obtained on the first three items The information also includes photographs of coated parts after tests, measurements of coating loss, amount of metal wall temperature reduction when the TBC is used, and extent of base metal corrosion (Author)

A79-35097 * **Error analysis of a satellite interferometer navigation system** G S Gopalapillai (Battelle Columbus Laboratories, Columbus, Ohio) *Marine Geodesy,* vol 2, no 3, 1979, p 247 267 11 refs Contract No NASw-2800 NASA Task 3

An error analysis is performed for a global positioning and navigation system which relies on an orthogonal array of interferometry baselines on board a geostationary satellite The error analysis involves linearization of a mathematical model which is based on the relationship between the measured phase differences, the known transmitter positions, and other systematic error parameters According to the error analysis, position accuracy is critically dependent on the baseline length and the magnitude of the random component of the measuring errors It is shown that a satellite interferometry system with baselines of about 50 m can yield position accuracies on the order of 20 m J M B

A79-35100 **Airline productivity redefined - An analysis of U S and European carriers** P S Morrell (Alistair Tucker Associates, London, England) and N K Taneja (MIT, Cambridge, Mass) *Transportation,* vol 8, Mar 1979, p 37-49 12 refs

It is suggested that productivity in terms of net value added per man year of labor and capital input, provides a more useful yardstick of airline efficiency than the widely used indices representing average unit costs or labor productivity European airlines productivity is lower than or equal to U S airlines These variations can be explained almost entirely by differences in level of service, demand patterns and route characteristics A regression model is used to indicate that productivity could be increased by changes in network shape through a more liberal exchange of traffic rights, greater specialization and consumer choice - by offering higher frequency, multi city service In addition, the model indicates that European airlines could increase their productivity by 2 2% by lowering their charter activity to the U S level M E P

A79-35110 # **Investigation of the regimes of flow past the upper surfaces of delta wings with shock waves separated from the leading edges (Issledovanie rezhimov obtekaniia verkhnei poverkhnosti V-obraznykh kryl'ev s otsoedinennym ot perednikh kromok skachkom uplotneniia)** Iu P Gun'ko and I I Mazhul' (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk,* Feb 1979, p 132 138 14 refs In Russian

An experimental study of flow characteristics on the upper surfaces of delta wings was conducted for the Mach number range of 1 75 4 0 Visualized surface streamlines and measured wing-span pressure distributions were used to study flow patterns for the case of shock waves detached from the leading edges Conditions of shock separation are established for cases of weak and strong shocks normal to the leading edges Experimental data are compared with calculated results B J

A79-35155 # **Parameters of three-dimensional flow past a wing near the free surface of a ponderable fluid (Parametry prostranstvennogo potoka pri obtekanii kryla vblizi svobodnoi poverkhnosti vesomoi zhidkosti)** A B Lukashevich *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar Apr 1979, p 54 62 10 refs In Russian

The three-dimensional flow past a submerged wing is studied on the basis of a singularity method wherein the effect of the free surface of the ponderable fluid is represented as the effect of an infinite layer of sources Particular consideration is given to the relationship between wave generation behind the wing and the separation of free vortices from the wing Downwash distribution behind the wing is investigated B J

A79-35158 # **Hypersonic viscous shock layer on infinite-span arrow wings at angle of attack (Giperzvukovoi viazkii udarnyi sloi na strelovidnykh kryliakh beskonechnogo razmakha, obtekaemykh pod uglom ataki)** I G Brykina and E A Gershbein *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar Apr 1979, p 91 102 13 refs In Russian

The paper presents a theoretical investigation of the flow of a viscous compressible gas in a hypersonic shock layer on infinite span arrow wings with blunt leading edges at angle of attack The hypersonic shock-layer equations are solved by the method of successive approximations, which permits an analytical solution for the first approximation as well as an exact numerical solution Formulas are presented for coefficients of friction and heat transfer on the surface of the body as well as for velocity and temperature profiles across the shock layer B J

A79-35210 **Multichannel infrared receiver performance** S J Dunning (USAF, Data Systems Div , Sunnyvale Air Force Station, Calif) and S R Robinson (USAF, Institute of Technology, Wright-Patterson AFB, Ohio) *Applied Optics,* vol 18, May 15, 1979, p 1567 1576 14 refs

The performance of an IR receiver designed to detect a target by taking advantage of the target's spectral signature is presented, with reference to such equipment as FLIR systems The receiver processes the signal in several narrow frequency bands and is based on a statistical model which represents the field in each band as a Gaussian random process whose moments depend on the target and background characteristics The optimal Bayes/Neyman-Pearson receiver structure for an M spectral channel, N sequential look receiver is presented and practical suboptimal receiver structures are developed Numerical methods are used to calculate the probability of false alarm and the probability of detection using identical parameters for each processor B J

A79-35449 **The derivation of a thickness noise formula for the far-field by Isom** F Farassat (Joint Institute for Advancement of Flight Sciences, Hampton, Va) *Journal of Sound and Vibration,* vol 64, May 8, 1979, p 159, 160 Army sponsored research

Isom (1975) derived a thickness noise formula for a hovering helicopter blade which is valid in the far field Isom derived his result using a frame fixed to the rotating blade, thus giving the impression that it is valid for a hovering rotor or a static propeller It is shown in the present paper that the formula is more general and is valid for any body in arbitrary motion B J

A79-35475 # **Technical characteristics and cost data for the Il 62 and Il-62M aircraft and optimal flight conditions (O niektorych charakterystykach techniczno-ekonomicznych samolotow Il 62 i Il 62M, z uwzglednieniem optymalnych zakresow przelotowych)** K Rzemek *Technika Lotnicza i Astronautyczna,* vol 34, Apr 1979, p 24 26 5 refs In Polish

A79-35501 # **Radio-engineering tracking systems (Radiotekhnicheskie sledíashchie sistemy)** V A Puzyrev *Radioelektronika,* vol 22, Mar 1979, p 3 9 17 refs In Russian

Optimal control theory is used in formulating the problem of designing a radio engineering tracking system Algorithms are presented which make it possible to realize a fully automated design procedure The control algorithm which is obtained includes optimal estimation and optimal control/tracking B J

A79-35502 # Optimal excitation of amplitude direction-finder antennas operating on the basis of the comparison method (Optimal'noe vozbuzhdenie antenn amplitudnykh pelengatorov, rabotaiushchikh po metodu sravneniia) B M Minkovich and Iu Iu Makhnenko *Radioelektronika,* vol 22, Mar 1979, p 10 17 15 refs In Russian

An analytic expression is obtained for minimization of the error of an amplitude-direction finder antenna system This expression, obtained in the form of a generalized integral parameter which takes into account the sidelobe power, is used to obtain explicit solutions to isoperimetric variational problems of optimal excitation of circular-aperture antennas Consideration is given to a monopulse direction finder and a direction finder with time separation of channels which operate on the basis of the comparison method B J

A79-35506 # Correlation-extremal direction finding of extended and point sources of electromagnetic oscillations (Korreliatsionno-ekstremal'noe pelengovanie protiazhennykh i tochechnykh istochnikov elektromagnitnykh kolebanii) V K Baklitskii *Radioelektronika,* vol 22, Mar 1979, p 41 45 6 refs In Russian

Nonlinear filtering is used to obtain an algorithm of optimal processing of signals from extended or point sources of electromag netic radiation This algorithm makes it possible to determine the discrimination factor of the direction finder The study is applied to methods of amplitude-difference, phase, and holographic direction finding B J

A79-35584 # Optimization of hypersonic three-dimensional shapes (Optimizatsiia giperzvukovykh prostranstvennykh form) Iu A Vedernikov, V G Dulov, and A F Latypov *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Jan -Feb 1979, p 65 71 10 refs In Russian

In the framework of a Newtonian flow scheme with friction correction, a new class of three dimensional configurations with power law longitudinal and transverse contours is considered, which includes, in particular, a body of revolution, multicantilever wings, and curvilinear semiwedge bodies with circular middle The values of the parameters determining the optimal streamline surface are determined by the method of random search over the best probe with the objective of minimizing the total body drag It was found that in the aspect ratio range 0-4 the optimal hypersonic shapes are bodies with star-shaped middle P T H

A79-35656 Effect of friction on motion of a piston driven by combustion products V A Poselevich, N N Piliugin, and S Iu Cherniavskii *(PMTF Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Sept Oct 1978, p 73 80) *Journal of Applied Mechanics and Technical Physics,* vol 19, no 5, Mar 1979, p 634 639 14 refs Translation

In recent years, the two stage light gas ballistic apparatus with deformable plastic pistons has become widely used in experimental aerodynamics The existing methods of calculating such devices either completely neglect friction of the piston against the channel walls, or use a schematization of the frictional forces which does not have a satisfactory physical basis In a number of studies, the friction force was considered constant and its value was specified not from physical considerations, but to produce the best agreement between calculated and experimental values of object velocity or driving gas pressure Since friction is such a significant factor, its proper consideration in calculating piston motion parameters requires special study In this connection, it is useful to consider the operation of only the first stage of the ballistic apparatus, which sets the piston in motion The present analysis deals with the internal ballistics of a one-stage powder-driven apparatus in which a piston made of polymer material performs a friction motion The friction model is constructed on the basis of a series of experiments on the slow forcing of polymer specimens compressed in the longitudinal direction through a steel channel (Author)

A79-35717 Optimization of wing structures to satisfy strength and frequency requirements V R Rao, N G R Iyengar, and S S Rao (Indian Institute of Technology, Kanpur, India) *Computers and Structures,* vol 10, Aug 1979, p 669-674 13 refs Research sponsored by the Ministry of Defence of India

In this investigation minimum weight design of wing structures with restrictions on strength, stability and frequency characteristics is attempted The multiweb delta wing structure is idealized with three different kinds of finite elements The constant stress triangular plate elements, the rectangular shear panels and pin jointed bar elements are used to represent, respectively, the cover skins, webs and the stringers of wing structures A parametric study is made to reduce the number of design variables which in turn reduces the required computational effort The feasibility of employing linearly approximated redesigns is investigated Numerical results are presented to illustrate the feasibility Off design charts have been obtained by performing sensitivity analysis about the final optimum design point (Author)

A79-35777 A finite element approach to subsonic aerodynamics W G Habashi (Concordia University, Montreal, Canada) *International Journal for Numerical Methods in Engineering,* vol 14, no 5, 1979, p 665-679 14 refs

A study of the application of the finite element method to compressible potential flows, typified by the airfoil problem, is undertaken Some novel approaches, believed to simplify solution techniques, are presented The solutions use two pseudo-variational integrals, appropriate to subsonic flows, and possessing a physical iterative basis With constant derivatives triangular elements formulated for cylindrical coordinates, accurate solutions are easily obtained for the flow over a circular cylinder For arbitrary airfoils a simple mapping is used to transform them into near circles An appropriate mesh is then constructed in the mapped plane The paper then presents two solution approaches by which this nonlinear problem is solved in both the near circle plane and the airfoil plane (Author)

A79-35895 Solution of boundary value problems for the vibration equation for a jet engine model (Losung von Randwertproblemen der Schwingungsgleichung fur ein Modell eines Triebwerkeinlaufs) N Friedrich (Saarland, Universitat, Saarbrucken, West Germany) *Mathematical Methods in the Applied Sciences,* vol 1, no 2, 1979, p 138-157 13 refs In German

A model of a jet engine consists of two coaxial cylinders, of which the inner extends in both directions to infinity and the outer is semi infinite The model is valid for a compressible and inviscid gas at subsonic velocity The induced pressure and velocity fields are sought for when (1) the speed distribution in the compressor inlet plane is given, and (2) the pressure distribution is given The Wiener Hopf method is applied to the acoustic approximation of the basic equations An infinite system of linear equations is obtained, involving the expansion coefficients of the solution with respect to the eigenfunctions of the concentric cylindrical duct The relevant information is extracted by using arguments from perturbation theory P T H

A79 35921 A method for the optimal layout of driving mechanisms of the aileron for gliders and motorplanes (Ein Verfahren zur optimalen Auslegung von mechanischen Ruderantrieben bei Segelflugzeugen und Motorsportflugzeugen) M Hiller (Stuttgart, Universitat, Stuttgart, West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumforschung,* vol 3, Mar Apr 1979, p 75-86 6 refs In German

A method is described which allows the layout of the spatial driving mechanism of the aileron for a glider or a motorplane to be

performed in a systematic manner In particular, a prescribed input output behavior of the mechanism can be realized by variation of individual parameters of the spatial four-bar mechanisms which constitute the entire driving mechanism At the same time the forces acting in the mechanism can be limited by imposing maximum values of the forces as secondary conditions during the variation process (Author)

A79-35923 A flyable suspended model helicopter for the investigation of the human pilot behaviour (Ein flugfahig eingespannter Modellhubschrauber zur Untersuchung des menschlichen Reglerverhaltens) W Oesterlin (Darmstadt, Technische Hochschule, Darmstadt, West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumforschung,* vol 3, Mar Apr 1979, p 98 108 12 refs In German

This paper describes the design and control of a servo-control mechanism with a model helicopter for the investigation of the human pilot behavior as a multi loop control component A simple multi-loop model for the behavior of a human pilot is presented for the hovering state The correspondence of the model with the human pilot behavior has been confirmed by simulation (Author)

A79-35925 An exploratory investigation of quasi-free flying models in a supersonic short-duration wind tunnel B N Pamadi (Indian Institute of Technology, Bombay, India) and G Schwarz (Stuttgart, Universitat, Stuttgart, West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumforschung,* vol 3, Mar -Apr 1979, p 116-125 14 refs

Experiments were conducted on the AGARD HB 2 calibration model in a 9 cm x 6 cm short duration supersonic wind tunnel at Ma = 3 6 where the quasi free flying model was always maintained in the test section viewing area throughout the run by a fine nylon thread (0 1 mm diam) The static and dynamic stability derivatives deduced from the time motion data agree well with the established results An interferometric study of the flow around the model with and without string showed that the flow separation over the string influences only the flow around the leading edge of the body and leads to a small drag reduction of about 7% (Author)

A79-35926 A special extension of the General Point Performance Equation (Spezielle Erweiterung der 'Allgemeinen Flugzustandsgleichung') M Kloster (Messerschmitt-Bolkow Blohm GmbH, Munich, West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumforschung,* vol 3, Mar -Apr 1979, p 125-129 In German

The General Point Performance Equation, as introduced by Bruning and Hafer (1978), is extended using a special set up of thrust and an exponential polar dependent on Mach number The dependence on density and Mach number is analyzed through approximation formulas such that the point of performance equation is simplified to enable the calculation of all flight regimes without difficulty The pitch angle as function of Mach number as well as the angle of the steepest climb are calculated using data given for a high-capacity transporter A A

STAR ENTRIES

N79-21996# Advisory Group for Aerospace Research and Development Paris (France)
HIGH ANGLE OF ATTACK AERODYNAMICS
Jan 1979 542 p refs In ENGLISH and FRENCH Conf held at Sandefjord Norway 4-6 Oct 1978
(AGARD-CP-247 ISBN-92-835-0230-2) Avail NTIS HC A23/MF A01

Reports were presented on (1) studies of configurations of practical application (10 papers) (2) mathematical modelling and supporting investigations (12 papers) (3) design methods (7 papers) and (4) air intakes (2 papers) Eight additional short presentations on these subjects are also documented

N79-21997# National Aeronautical Establishment Ottawa (Ontario) Unsteady Aerodynamics Lab
EFFECT OF HIGH ANGLES OF ATTACK ON DYNAMIC STABILITY PARAMETERS
K J Orlik-Rueckemann *In* AGARD High Angle of Attack Aerodyn Jan 1979 14 p refs

Avail NTIS HC A23/MF A01

Effects of flight at high angles of attack are presented for dynamic stability parameters and their significance for the analysis of aircraft motion at those flight conditions The topics included (1) the strong nonlinear variations of many stability parameters with angle of attack (2) the emergence of new categories of parameters such as cross-coupling derivatives that are only of interest for high angle-of-attack or other asymmetrical flight conditions (3) the significance of time-dependent parameters such as represented by derivatives due to time rates of change of angles of attack and sideslip (4) the strong configuration dependence of aerodynamic characteristics as illustrated by large effects of strakes and of various shapes of aircraft forebody and (5) the need for establishing and verifying a mathematical model that would satisfactorily describe the motion of an aircraft in the presence of all these high angle-of-attack effects J A M

N79-21998# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
HIGH ANGLE OF ATTACK CHARACTERISTICS OF DIFFERENT FIGHTER CONFIGURATIONS
H John and W Kraus *In* AGARD High Angle of Attack Aerodyn Jan 1979 15 p refs

Avail NTIS HC A23/MF A01

Increased maneuverability at the lower end of the flight envelope offers new and attractive possibilities for fighter aircraft To extend the flight regime at low speeds up to high angles of attack beyond maximum lift requires the ability to trim and control the aircraft and by this avoid departure and spin susceptibility at those conditions Basic aerodynamic characteristics of different fighter configurations at separated flow beyond maximum lift are reviewed where the resultant derivatives are completely different from those associated with attached flow The change in trim conditions is primarily dependant on wing planform and overall aircraft configuration Results are shown about the aerodynamic development of aircraft configuration which meet these requirements and at the same time minimize the resulting drag penalties in the conventional angle of attack regime J A M

N79-21999# Royal Aircraft Establishment Farnborough (England)
SOME UK RESEARCH STUDIES OF THE USE OF WING-BODY STRAKES ON COMBAT AIRCRAFT CONFIGURATIONS AT HIGH ANGLES OF ATTACK
G F Moss *In* AGARD High Angle of Attack Aerodyn Jan 1979 19 p refs
Avail NTIS HC A23/MF A01

Experimental research of interest to design engineers incorporating strakes in combat-aircraft configurations is considered It is likely to be many years before a satisfactory mathematical model is achieved for the detailed flow about such configurations and there is thus an urgent need to explore the various aerodynamic features of these devices experimentally both to obtain satisfactory solutions to current problems and to guide theoretical work which will form the basis of future design methods Author

N79-22000*# General Dynamics/Fort Worth Tex
DESIGN GUIDELINES FOR THE APPLICATION OF FOREBODY AND NOSE STRAKES TO A FIGHTER AIRCRAFT BASED ON F-16 WIND TUNNEL TESTING EXPERIMENT

C W Smith and C A Anderson *In* AGARD High Angle of Attack Aerodyn Jan 1979 11 p refs

(Contract NAS1-15006)
Avail NTIS HC A23/MF A01 CSCL 01C

During the YF-16 and F-16 developmental wind tunnel test program numerous variations in nose and forebody strakes were investigated These data were reviewed and the strake aerodynamic characteristics coalesced into design guidelines for the application of strakes to fighter aircraft The design guides take the form of general equations governing the modification of forebody strakes to obtain a linear pitching moment curve and the calculation of the resulting lift and drag increments Additionally qualitative comments are made concerning the effects of strake geometry on lateral/directional stability It is concluded that the generation of incremental strake lift is primarily dependent upon the area affected by the strake-induced vortex and that strake planform is of secondary importance Forebody strakes have small beneficial effects on lateral/directional stability if properly designed however significant gains are easily attained with nose strakes J A M

N79-22001# Northrop Corp Hawthorne Calif Aerodynamics Research Dept
FOREBODY/WING VORTEX INTERACTIONS AND THEIR INFLUENCE ON DEPARTURE AND SPIN RESISTANCE

A M Skow A Titiriga Jr and W A Moore *In* AGARD High Angle of Attack Aerodyn Jan 1979 26 p refs

Avail NTIS HC A23/MF A01

In-depth studies were conducted to determine the effects of these shed vortices and to isolate parameters which strongly influence them Arising from these studies methodologies were developed which can be used as general guidelines in the design of both aircraft forebody shapes and hybrid-wing planform shapes such that the interactions between these vortex systems will enhance aircraft stability J A M

N79-22002# Royal Aircraft Establishment Farnborough (England)
STRAKE-INDUCED SEPARATION FROM THE LEADING EDGES OF WINGS OF MODERATE SWEEP
S P Fiddes and J H B Smith *In* AGARD High Angle of Attack Aerodyn Jan 1979 12 p refs

Avail NTIS HC A23/MF A01

Mechanisms were proposed to account for the observation that on a wing of moderate sweep and aspect ratio leading edge separation occured at a lower incidence when strakes (i e highly swept forward extensions to the wing root) were attached ahead of it The effect on the main wing of the vortices resulting from the leading edge separation on the strake was considered and a simplified approach to modelling the flow over strake-wing combinations was introduced J A M

N79-22003# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)

AERODYNAMIC CHARACTERISTICS OF A FIGHTER-TYPE CONFIGURATION DURING AND BEYOND STALL
W Staudacher B Laschka P Poisson-Quinton (ONERA Paris France) and J P Ledy (ONERA Paris France) *In* AGARD High Angle of Attack Aerodyn Jan 1979 15 p refs

Avail NTIS HC A23/MF A01

Low speed wind tunnel tests were conducted with a MBB pilot model Angle of attack regime investigated comprised alpha = 0 divided by 90 deg Emphasis was directed towards the stability and/or control contributions of configurational items such as strakes canards tails, rudders and controls and maneuver flap systems as well as the technique of concentrated spanwise blowing Isolated and combined effects of those devices and systems are demonstrated and some unconventional control devices are introduced J A M

N79-22004# Lockheed-Georgia Co Marietta Flight Sciences Div
THE APPLICATION OF SPANWISE BLOWING FOR HIGH ANGLE OF ATTACK SPIN RECOVERY
J J Cornish III and M W M Jenkins *In* AGARD High Angle of Attack Aerodyn Jan 1979 12 p

Avail NTIS HC A23/MF A01

A unique autorotation tunnel test was performed on a 1/30th scaled model of an F-4 fighter configuration During this test air was blown spanwise over the wing from various nozzle locations and the influence of this blowing on the spinning mode was recorded Over 50 test conditions were evaluated for both flat (alpha = 45 degrees) and steep (alpha = 80 degrees) spin modes The wing blowing was very effective in arresting the spin for the steep spin mode and not very effective in stopping the flat spin Nose blowing was also evaluated with only marginal success An optimum wing nozzle location and blowing level was identified These data when scaled to full-scale values showed that the required nozzle diameter was 1 92 inches located close to the wing root 1/4 chord point and 18 lb/sec of air was required to affect recovery More efficient and effective recovery is possible in the tunnel with an additional degree of freedom and with empennage blowing Further larger scale testing is urged G Y

N79-22005# Societe Nationale Industrielle Aerospatiale Toulouse (France)
BEHAVIOR OF A TRANSPORT AIRCRAFT WITH A HIGH ASPECT RATIO WING AT A HIGH ANGLE OF INCIDENCE [COMPORTEMENT A HAUTE INCIDENCE U'UN AVION DE TRANSPORT A AILE A GRAND ELANCEMENT]
D Collard *In* AGARD High Angle of Attack Aerodyn Jan 1979 12 p In FRENCH

Avail NTIS HC A23/MF A01

Results of wind tunnel test on a model of a Concorde supersonic transport aircraft with a high aspect ration wing at a high angle of incidence are reported Graphs and especially flow visualization charts of the air flow over the top of the airfoil are presented Transl by G Y

N79-22007# Office National d Etudes et de Recherches Aerospatiales Paris (France)
VORTEX PATTERN DEVELOPING ON THE UPPER SURFACE OF A SWEPT WING AT HIGH ANGLE OF ATTACK
Jean Mirande Volker Schmitt and Henri Werle *In* AGARD High Angle of Attack Aerodyn Jan 1979 18 p refs In FRENCH ENGLISH summary

Avail NTIS HC A23/MF A01

An experimental study based on a swept wing was undertaken in a water tunnel and a wind tunnel at low speeds (V sub o less than or equal to 90 m/s) The vortex flow effects on this wing are illustrated from global effort measurements and static pressure distributions The domain of vortex appearance was deduced as a function of both sweep angle and angle of attack An attempt is made to describe the physical pattern of the vortex flow from its formation near the apex to its breakdown at the trailing edge By means of a directional probe the flow over the wing was determined G Y

N79-22021# Boeing Aerospace Co Seattle Wash
SUBCRITICAL DRAG MINIMIZATION FOR HIGHLY SWEPT WINGS WITH LEADING EDGE VORTICES
E N Tinoco and H Yoshihara *In* AGARD High Angle of Attack Aerodyn Jan 1979 9 p refs

Avail NTIS HC A23/MF A01

The subsonic lift to drag ratio of supercruiser type wings was studied at sufficiently large lifts for which flow separation cannot be avoided In the presence of the resulting leading edge vortex minimum drag due to lift is no longer dictated by spanwise load distribution alone but is also a function of the chordwise loading For the resulting nonlinear problem a higher order panel method utilizing a vortex sheet model is used to search for an optimal design A brief outline of the computational method is given fllowed by examples validating the procedures Results of the search for an optimal camber are discussed M M M

N79-22022# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
NORMAL FORCE AND PITCHING MOMENT OF WING-BODY COMBINATIONS IN THE NONLINEAR ANGLE-OF-ATTACK RANGE AT SUBSONIC SPEEDS
C P Schneider and D Nikolitsch *In* AGARD High Angle of Attack Aerodyn Jan 1979 10 p refs

Avail NTIS HC A23/MF A01

Two procedures on the nonlinear lifting surface theory are presented One method for the determination of the factor K sub B(W) represents the effect of the wing on the body-forces and moments due to lift carry-over and predicts the normal force interference factors The other method determines K sub B(W) It uses the nonlinear lifting surface theory for the calculation of normal force and moment of a slowly pitching wing alone and to get the same quantities for a substitute wing which represents the original wing plus a rectangular flat middle section in place of the body between the wing root chords The results of the two procedures call for an improved prediction method as comparable quasi-steady data from experiments which may serve to confirm the results of one or the other method are not available at present Free vortex tracing of discrete vortices by conventional two-dimensional theory is proposed Viscous vortices with core are assumed M M M

N79-22023*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
PREDICTION OF AERODYNAMIC CHARACTERISTICS FOR SLENDER BODIES ALONE AND WITH LIFTING SURFACES TO HIGH ANGLES OF ATTACK
Leland H Jorgensen *In* AGARD High Angle of Attack Aerodyn Jan 1979 40 p refs

Avail NTIS HC A23/MF A01 CSCL 01A

A method is presented for computing normal force and pitching moment coefficients for slender bodies of circular and noncircular cross section alone and with lifting surfaces A semiempirical term representing viscous-separation crossflow is added to a term representing potential-theory crossflow For bodies of revolution computed aerodynamic characteristics agree with measured results for investigated free-stream Mach numbers from 0 6 to 2 9 and for angles of attack from 0 deg to 180 deg For bodies of elliptic cross section measured results are predicted well over the investigated Mach number range from 0 6 to 2 0 and the angle range from 0 deg to 60 deg For all bodies the predictions are best at supersonic Mach numbers For body-wing and body-wing-tail configurations measured normal force coefficients and centers are predicted at the upper test Mach number of 2 0 As the Mach number is decreased to 0 6 the agreement for the normal-force coefficients rapidly deteriorates When model flow-separation and vortex patterns are asymmetric undesirable side forces are usually measured on the models at

subsonic Mach numbers and zero sideslip angle Generally the side-force coefficients decrease or vanish with increase in Mach number decrease in nose fineness ratio nose blunting and flattening of body cross section M M M

N79-22024# Nielsen Engineering and Research Inc Mountain View Calif

PREDICTION OF LATERAL AERODYNAMIC LOADS ON AIRCRAFT AT HIGH ANGLES OF ATTACK

S B Spangler S C Perkins Jr and M R Mendenhall *In* AGARD High Angle of Attack Aerodyn Jan 1979 14 p refs

Avail NTIS HC A23/MF A01

The lateral loads on high speed fighter-bomber configurations at high angles of attack and small angles of sideslip were studied The configurations of interest are characterized by slender pointed noses that generate asymmetric separation vortices at angles of attack in the 25 to 45 degree range The methods consist of a nose vortex shedding flow model a vortex lattice wing/body/strake flow model and a tail interference model All are potential flow methods and were applied at incompressible speeds The methods account for noncircular nose cross sections prediction of separation location on the nose and interaction between nose and strake vortices Calculations were made to compare the predicted results with measurements of vorticity distribution velocities in the separated region and forces on noncircular noses and forces and moments on complete aircraft configurations The predicted results agree with the data show the proper trends and demonstrate the proper physical characteristics of the flow M M M

N79-22025# Systems Research Labs Inc Newport News Va

PREDICTION AND MEASUREMENT OF THE AERODYNAMIC FORCES AND PRESSURE DISTRIBUTIONS OF WING-TAIL CONFIGURATIONS AT VERY HIGH ANGLES OF ATTACK

Richard P White Jr *In* AGARD High Angle of Attack Aerodyn Jan 1979 16 p refs

Avail NTIS HC A23/MF A01

The three-dimensional viscous lifting surface theory that developed to predict the distribution of aerodynamic loading on arbitrary planforms having attached vortex flows at high angles of attack is discussed Comparisons between measured and predicted performance and pressure distribution data for a wing-strake configuration at a high angle of attack are reported Limitations of the prediction technique as well as the potential of utilizing vortex lift to amplify the performance characteristics of highly maneuverable aircraft is outlined M M M

N79-22026*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

HIGH ANGLE OF INCIDENCE IMPLICATIONS UPON AIR INTAKE DESIGN AND LOCATION FOR SUPERSONIC CRUISE AIRCRAFT AND HIGHLY MANEUVERABLE TRANSONIC AIRCRAFT

Leroy L Presley *In* AGARD High Angle of Attack Aerodyn Jan 1979 10 p refs

Avail NTIS HC A23/MF A01 CSCL 01C

The effects of angle of attack on supersonic mixed compression inlet performance at four different locations about a hypothetical forebody are given A computational method to predict optimum inlet location orientation and centerbody control schedule for design and off-design performance is described The effects of inlet location and a forward canard on the angle-of-attack performance of a normal shock inlet at transonic speeds were studied Proper integration of inlet location and a forward canard can enhance the angle-of-attack performance of a normal shock inlet Two lower lip treatments for improving the angle-of-attack performance of rectangular inlets at transonic speeds are discussed M M M

N79-22027# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany) Military Airplane Div

INTAKE DESIGN AND INTAKE/AIRFRAME INTEGRATION FOR A POST-STALL FIGHTER AIRCRAFT CONCEPT

K W Lotter and J Malefakis *In* AGARD High Angle of Attack Aerodyn Jan 1979 16 p refs

Avail NTIS HC A23/MF A01

Results from subsonic scale model tests carried out for intake geometries especially designed for high angle of attack capability are discussed A unit-composed intake model representing a twin-engine fighter aircraft was tested with two basic intake positions in a shielded location one under the fuselage and one under the wing strakes on both sides of the fuselage Two different axial positions were tested An external compression horizontal ramp inlet design was chosen for the tests Different auxiliary intakes, all fitted to the lower side of the intake were tested Various rotatable forward cowl lip designs and a cowl slot were included in the investigations A shielded intake location offers a high potential for improvement in inlet maneuver capability Sufficient shielding is generally given for the under-fuselage position For the side-intakes located under the strakes a position as far downstream as possible is desirable For such shielded intakes only small performance losses occurred at incidences up to 35 deg Variable cowl lip geometry introduced for subsonic maneuver improvement offers an attractive means for optimum intake/engine mass flow matching at supersonic speeds by varying the intake capture area M M M

N79-22029# Royal Inst of Tech Stockholm (Sweden) Dept of Aeronautics

WIND TUNNEL TEST AT LOW SPEEDS OF A DORSAL AIR INTAKE ON A FIGHTER CONFIGURATION

Sven-Olof Ridder *In* AGARD High Angle of Attack Aerodyn Jan 1979 3 p

Avail NTIS HC A23/MF A01

A wind tunnel model with a swept wing and a dorsal air intake mounted well aft on the fuselage was investigated in a low speed wind tunnel with respect to the flow quality of the air intake flow It was found that the air intake flow was satisfactory at zero angle of yaw for angles of attack up to 20 degrees Even a moderate angle of yaw however resulted in a rather high level of intake flow distortion as caused by the ingestion of forebody vortices A large number of forebody mounted flow control devices were tested and among these only a canopy mounted device was found effective in reducing the intake flow distortion to an acceptable level J A M

N79-22030# Avions Marcel Dassault-Breguet Aviation Saint-Cloud (France)

VISUALISATIONS AND CALCULATIONS OF AIR INTAKES AT HIGH ANGLES OF ATTACK AND LOW REYNOLDS NUMBER

P C Perrier and J Periaux *In* AGARD High Angle of Attack Aerodyn Jan 1979 2 p refs In FRENCH

Avail NTIS HC A23/MF A01

The operation of compressors can be strongly perturbed at a high angle of incidence by the instability of the flow created by separation at the edges of the air intake Both flow visualization and the direct solution numerical solution of the Navier-Stokes equation are complementary methods of analyzing the phenomena To visualize what is intervening at the interior of the air intake the flow can be studied at very low velocity and at a low Reynolds number by the injection of colored fluid in a two dimensional flow in a hydrodynamic test tunnel so that an ultra ultra-rapid film of the transonic stream lines can be obtained The instability of the separation of at the air intake can be calculated only by the exact or approximate solution of the Navier-Stokes equation Results obtained by using a least squares finite element method for the direct solution of the Navier-Stokes instability equation are presented This method resolves the nonlinearity of the equation by iteration of the Stokes equation which is itself resolved in an original manner Transl by A R H

N79-22032# Bristol Univ (England) Dept of Aeronautical Engineering

ON SLENDER WINGS WITH LEADING EDGE CAMBER

R K Nangia *In* AGARD High Angle of Attack Aerodyn Jan 1979 10 p refs
Avail NTIS HC A23/MF A01

The presence of leading edge camber on wing or wing body configuration of low aspect ratio is known to improve their aerodynamic efficiency A research program to develop design methods on this subject is reviewed J A M

N79-22033# Technische Hogeschool Delft (Netherlands) Dept of Aerospace Engineering
AN EXPERIMENTAL INVESTIGATION OF THE ENTRAINMENT OF A LEADING-EDGE VORTEX
N G Verhaagen and L vanderSnoek *In* AGARD High Angle of Attack Aerodyn Jan 1979 5 p refs

Avail NTIS HC A23/MF A01

An experimental investigation of the flow field of a leading edge vortex produced by a sharp edged unit aspect ratio delta wing at an angle of attack of 20 deg was carried out at 45 m/sec Velocity and total pressure distributions were obtained by using a fixed-attitude five-hole probe On the basis of the experimental results a number of control volumes of different cross sectional dimensions enclosing the rotational vortex core were chosen For each of the control volumes the entrainment was estimated J A M

N79-22034# Aeritalia S p A Torino (Italy) Combat Aircraft Div
A SURVEY OF RECENT HIGH ANGLE OF ATTACK, WIND TUNNEL TESTING AT AERITALIA
G Bucciantini R DeSilvestro and L Fornaster *In* AGARD High Angle of Attack Aerodyn Jan 1979 4 p refs

Avail NTIS HC A23/MF A01

The present status of investigation on wind tunnel testing techniques at high angles of attack and on stall/post stall characteristics of configurations typical of modern combat aircraft is illustrated Author

N79-22035*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
LOW-SPEED WIND-TUNNEL INVESTIGATION OF A LARGE-SCALE VTOL LIFT-FAN TRANSPORT MODEL
Kiyoshi Aoyagi Apr 1979 72 p refs
(NASA-TM-78560 A-7734) Avail NTIS HC A04/MF A01 CSCL 01A

An investigation was conducted in the NASA-Ames 40 by 80 Foot Wind Tunnel to determine the aerodynamic characteristics of a large scale VTOL lift fan jet transport model The model had two lift fans at the forward portion of the fuselage a lift fan at each wing tip and two lift/cruise fans at the aft portion of the fuselage All fans were driven by tip turbines using T-58 gas generators Results were obtained for several lift fan exit vane deflections and lift/cruise fan thrust deflections are zero sideslip Three component longitudinal data are presented at several fan tip speed ratios A limited amount of six component data were obtained with asymmetric vane settings All of the data were obtained without a horizontal tail Downwash angles at a typical tail location are also presented Author

N79-22036*# Colorado State Univ Fort Collins Dept of Civil Engineering
EFFECTS OF TURBULENCE ON LAMINAR SEPARATION ON AERODYNAMIC SURFACES SUCH AS AIRFOILS AND COMPRESSOR BLADING Semiannual Status Report, 1 Oct 1978 - 31 Mar 1979
Willy Z Sadeh Apr 1979 8 p refs
(Grant NsG-3127)
(NASA-CR-158488 CSU-31-1372-1935) Avail NTIS HC A02/MF A01 CSCL 01A

Activities report include (1) completion of measurements of turbulence amplification in flow about a circular cylinder (2) initiation of the measurements of turbulence characteristics in flow about a single symmetric airfoil and (3) further examination of various matching numerical methods Emphasis is placed on the experimental program conducted to obtain data on the amplification of the oncoming turbulence and its management A R H

N79-22037*# National Aeronautics and Space Administration Langley Research Center Hampton Va
EXPERIMENTAL INVESTIGATION OF THREE HELICOPTER ROTOR AIRFOILS DESIGNED ANALYTICALLY
Gene J Bingham and Kevin W Noonan Apr 1979 95 p refs Prepared in cooperation with Army Aviation Res and Develop Command Hampton Va
(DA Proj 1L1-61102-AH-45)
(NASA-TP-1396 L-11703 AVRADCOM-TR-79-11) Avail NTIS HC A05/MF A01 CSCL 01A

Three helicopter rotor airfoils designed analytically were investigated in a wind tunnel at Mach numbers from about 0 30 to 0 90 and Reynolds from about 0 8 to 2 3 x 10 to the 6th power The airfoils had thickness-to-chord ratios of 0 08 0 10 and 0 12 with maximum thickness at 40 percent chord The camber distribution of each section was the same with maximum camber at 35 percent chord The 10-percent-thick airfoil was also investigated at Reynolds numbers from 4 8 to 9 4 x 10 to the 6th power The drag divergence Mach number of the 10-percent-thick airfoil is about 0 83 at a normal-force coefficient of 0 and about 0 72 at a normal-force coefficient of 0 6 at Reynolds numbers near 9 x 10 to the 6th power The maximum normal-force coefficient is slightly less than that of the NACA 0012 airfoil tested in the same facility The results indicate that a qualitative evaluation of the drag divergence can be made at normal-force coefficients up to the onset of boundary-layer separation by analytically predicting the onset of sonic flow at the airfoil crest The qualitative results are conservative with respect to experimental values with the experimental drag divergence Mach number up to 0 05 higher than that indicated by analysis Author

N79-22038*# National Aeronautics and Space Administration Langley Research Center Hampton Va
LOW-SPEED WIND-TUNNEL PARAMETRIC INVESTIGATION OF FLIGHT SPOILERS AS TRAILING-VORTEX-ALLEVIATION DEVICES ON A TRANSPORT AIRCRAFT MODEL
Delwin R Croom Washington Apr 1979 46 p refs
(NASA-TP-1419 L-12622) Avail NTIS HC A03/MF A01 CSCL 01A

The trailing-wing sensor technique was used in the Langley V/STOL tunnel to determine the effectiveness of 11 combinations of the existing flight-spoiler segments on a jumbo-jet transport aircraft model when they were deflected as trailing-vortex-alleviation devices All 11 of the flight-spoiler configurations investigated were effective in reducing the induced rolling moment on the trailing model This investigation is an extension of earlier wind-tunnel and flight tests which showed that the existing flight spoilers on the jumbo-jet aircraft can be used as effective trailing-vortex-alleviation devices Essentially all of the reduction in induced rolling moment on the trailing-wing model was realized at a spoiler deflection of 45 deg for single-spoiler configurations 30 for two-spoiler configurations and 15 deg for both the three- and four-spoiler configurations Of the 11 flight-spoiler configurations investigated the most promising configuration for trailing-vortex abatement on the jumbo-jet aircraft appears to be the three inboard flight spoilers deflected 15 deg A R H

N79-22039*# Boeing Vertol Co Philadelphia Pa
ROTARY-WING AERODYNAMICS VOLUME 1 BASIC THEORIES OF ROTOR AERODYNAMICS WITH APPLICATION TO HELICOPTERS
W Z Stepniewski Washington NASA Jan 1979 302 p refs
(Contract NAS2-7007)
(NASA-CR-3082) Avail NTIS HC A14/MF A01 CSCL 01A

The concept of rotary-wing aircraft in general is defined The energy effectiveness of helicopters is compared with that of other static thrust generators in hover as well as with various air and ground vehicles in forward translation The most important aspects of rotor-blade dynamics and rotor control are reviewed The simple physicomathematical model of the rotor offered by

the momentum theory is introduced and its usefulness and limitations are assessed The combined blade-element and momentum theory approach which provides greater accuracy in performance predictions, is described as well as the vortex theory which models a rotor blade by means of a vortex filament or vorticity surface The application of the velocity and acceleration potential theory to the determination of flow fields around three dimensional non-rotating bodies as well as to rotor aerodynamic problems is described Airfoil sections suitable for rotors are also considered A R H

N79-22040*# Battelle Columbus Labs Ohio
EXTENDED ANALYTICAL STUDY OF THE FREE-WING/FREE-TRIMMER CONCEPT Final Report
Richard F Porter David W Hall and Rodolfo D Vergara Apr 1979 95 p refs
(Contract NAS4-2498)
(NASA-CR-3135) Avail NTIS HC A05/MF A01 CSCL 01A

The free wing/free trimmer concept was analytically studied in order to (1) compare the fore and aft trimmer configurations on the basis of equal lift capability rather than equal area (2) assess the influence of tip mounted aft trimmers both free and fixed on the lateral directional modes and turbulence responses (3) examine the feasibility of using differential tip mounted trimmer deflection for lateral control (4) determine the effects of independent fuselage attitude on the lateral directional behavior and (5) estimate the influence of wing sweep on dynamic behavior and structural weight Results indicate that the forward trimmer concept is feasible with the reduced size examined but it remains inferior to the aft trimmer in every respect except structural weight Differential motion of the aft trimmer is found to provide powerful lateral control while the effect of fuselage deck angle is a reduction of the dutch roll damping ratio for nose-down attitudes J M S

N79-22041*# Applied Physics Lab Johns Hopkins Univ Laurel Md
BUMBLEBEE PROGRAM AERODYNAMIC DATA PART 4 WING LOADS AT MACH NUMBERS 1 5 AND 2 0 Final Report
G A Barnes and L L Cronvich Washington NASA Apr 1979 46 p ref
(NASA Order L-60036-A)
(NASA-CR-3117) Avail NTIS HC A03/MF A01 CSCL 01A

Individual wing panel aerodynamic characteristics are provided for rectangular wings with aspect ratios of 0 25 0 75 and 1 00 each panel at Mach numbers if 1 5 and 2 0 for angles of attack to 23 degrees Data plots produced from reports of wind tunnel tests show normal force coefficients, and the spanwise and chordwise center of pressure locations A R H

N79-22046*# Vought Corp Hampton, Va
AERODYNAMIC DESIGN AND ANALYSIS OF THE AST-200 SUPERSONIC TRANSPORT CONFIGURATION CONCEPT
Kenneth B Walkley and Glenn L Martin Apr 1979 47 p refs
(Contract NAS1-13500)
(NASA-CR-159051) Avail NTIS HC A03/MF A01 CSCL 01A

The design and analysis of a supersonic transport configuration was conducted using linear theory methods in conjunction with appropriate constraints Wing optimization centered on the determination of the required twist and camber and proper integration of the wing and fuselage Also included in the design are aerodynamic refinements to the baseline wing thickness distribution and nacelle shape Analysis to the baseline and revised configurations indicated an improvement in lift-to-drag ratio of 0 36 at the Mach 2 7 cruise condition Validation of the design is planned through supersonic wing tunnel tests J M S

N79-22051*# National Aeronautics and Space Administration Langley Research Center Hampton Va
SURFACE PRESSURE DATA FOR A SUPERSONIC-CRUISE AIRPLANE CONFIGURATION AT MACH NUMBERS OF 2 30, 2 96, 3 30
Barrett L Shrout William A Corlett and Ida K Collins May 1979 56 p refs
(NASA-TM-80061 L-12777) Avail NTIS HC A04/MF A01 CSCL 01A

The tabulated results of surface pressure tests conducted on the wing and fuselage of an airplane model in the Langley Unitary Plan wind tunnel are presented without analysis The model tested was that of a supersonic-cruise airplane with a highly swept arrow-wing planform two engine nacelles mounted beneath the wing and outboard vertical tails Data were obtained at Mach numbers of 2 30 2 96 and 3 30 for angles of attack from -4 deg to 12 deg The Reynolds number for these tests was 6 560 000 per meter Author

N79-22052*# United Technologies Research Center East Hartford Conn
THE INFLUENCE OF SWEEP ON THE AERODYNAMIC LOADING OF AN OSCILLATING NACA 0012 AIRFOIL VOLUME 1 TECHNICAL REPORT Final Report
A O St Hilaire F O Carta M R Fink and W D Jepson (Sikorsky Aircraft) May 1979 138 p refs
(Contract NAS1-14873)
(NASA-CR-3092) Avail NTIS HC A07/MF A01 CSCL 01A

Aerodynamic experiments were performed on an oscillating NACA 0012 airfoil utilizing a tunnel-spanning wing in both unswept and 30 degree swept configurations The airfoil was tested in steady state and in oscillatory pitch about the quarter chord The unsteady aerodynamic loading was measured using pressure transducers along the chord Numerical integrations of the unsteady pressure transducer responses were used to compute the normal force chord force and moment components of the induced loading The effects of sweep on the induced aerodynamic load response was examined For the range of parameters tested it was found that sweeping the airfoil tends to delay the onset of dynamic stall Sweeping was also found to reduce the magnitude of the unsteady load variation about the mean response It was determined that at mean incidence angles greater than 9 degrees, sweep tends to reduce the stability margin of the NACA 0012 airfoil however for all cases tested the airfoil was found to be stable in pure pitch Turbulent eddies were found to convect downstream above the upper surface and generate forward-moving acoustic waves at the trailing edge which move upstream along the lower surface J M S

N79-22057# Naval Ship Research and Development Center Bethesda Md Aviation and Surface Effects Dept
AERODYNAMIC CHARACTERISTICS OF THE CLOSE-COUPLED CANARD AS APPLIED TO LOW-TO-MODERATE SWEPT WINGS VOLUME 1 GENERAL TRENDS Final Report, 1970 - 1974
David W Lacey Jan 1979 68 p ref
(WF1412109)
(AD-A063819 AERO-1256-Vol-1 DTNSRDC-79-001-Vol-1) Avail NTIS HC A04/MF A01 CSCL 01/3

A summary of the general findings of close-coupled canard research at David W Taylor Naval Ship Research and Development Center is presented These findings are based on a series of wind-tunnel evaluations utilizing an aircraft research model having wings of either 25 or 50 degree leading edge sweep Discussed is the effect of canard placement on lift, drag and pitching moment and the location of optimum position for canards of different planform In addition the effects of canard-wing interference canard deflection size and Mach number are described Author (GRA)

N79-22061*# National Aeronautics and Space Administration Langley Research Center Hampton Va
DEMAND FOR LARGE FREIGHTER AIRCRAFT AS PROJECTED BY THE NASA CARGO/LOGISTICS AIRLIFT SYSTEM STUDIES
Allen H Whitehead Jr and William H Kuhlman (McDonnel-Douglas Corp) Apr 1979 34 p refs Presented at the AIAA Very Large Vehicle Conf Arlington Va 26-27 Apr 1979
(NASA-TM-80074) Avail NTIS HC A03/MF A01 CSCL 01C

The market conditions are examined up through the year 2008 to provide a preliminary assessment of the potential

for and the characteristics of an advanced all-cargo transport aircraft Any new freighter must compete with current wide-body aircraft and their derivatives Aircraft larger than the wide-bodies may incur economic penalties and operational problems A lower direct operating cost is not a sufficient criterion to base a decision for the initiation of a new aircraft development or to select aircraft characteristics Other factors of equal importance that are reviewed in this paper include considerations of the system infrastructure the economics of the airlines and the aircraft manufacturer return on investment The results of the market forecast and a computer simulation show that an advanced long range aircraft with a payload between 68 to 181 tonnes (75 to 200 tons) could generate a solid foothold beginning around 1994 L S

N79-22062*# Massachusetts Inst of Tech Cambridge Dept of Aeronautics and Astronautics

AN ANALYSIS OF LONG AND MEDIUM-HAUL AIR PASSENGER DEMAND, VOLUME 1 Final Report

Steven E Eriksen 1978 75 p refs
(Grant NsG-2129)
(NASA-CR-152156) Avail NTIS HC A04/MF A01 CSCL 05C

A basic model was developed which is a two equation pair econometric system in which air passenger demand and airline level-of-service are the endogenous variables The model aims to identify the relationship between each of these two variables and its determining factors and to identify the interaction of demand and level-of-service with each other The selected variable for the measure of air passenger traffic activity in a given pair market is defined as the number of passengers in a given time that originate in one region and fly to the other region for purposes other than to make a connection to a third region For medium and long haul markets the model seems to perform better for larger markets This is due to a specification problem regarding the route structure variable In larger markets a greater percentage of nonlocal passengers are accounted for by this variable Comparing the estimated fare elasticities of long and medium haul markets it appears that air transportation demand is more price elastic in longer haul markets Long haul markets demand will saturate with a fewer number of departures than will demand in medium haul markets A R H

N79-22063*# Massachusetts Inst of Tech Cambridge Dept of Aeronautics and Astronautics

AN ANALYSIS OF SHORT HAUL AIR PASSENGER DEMAND, VOLUME 2 Final Report

Terry P Blumer and William M Swan 1978 132 p refs
(Grant NsG-2129)
(NASA-CR-152157) Avail NTIS HC A07/MF A01 CSCL 05C

Several demand models for short haul air travel are proposed and calibrated on pooled data The models are designed to predict demand and analyze some of the motivating phenomena behind demand generation In particular an attempt is made to include the effects of competing modes and of alternate destinations The results support three conclusions (1) the auto mode is the air mode s major competitor (2) trip time is an overriding factor in intermodal competition with air fare at its present level appearing unimportant to the typical short haul air traveler and (3) distance appears to underly several demand generating phenomena and therefore must be considered very carefully to any intercity demand model It may be the cause of the wide range of fare elasticities reported by researchers over the past 15 years A behavioral demand model is proposed and calibrated It combines the travel generating effects of income and population the effects of modal split the sensitivity of travel to price and time and the effect of alternative destinations satisfying the trip purpose A R H

N79-22064*# Massachusetts Inst of Tech Cambridge Dept of Aeronautics and Astronautics

AN ECONOMIC MODEL OF THE MANUFACTURERS' AIRCRAFT PRODUCTION AND AIRLINE EARNINGS POTENTIAL, VOLUME 3 Final Report

James T Kneafsey and Richard M Hill 1978 185 p refs
(Grant NsG-2129)
(NASA-CR-152158) Avail NTIS HC A09/MF A01 CSCL 05C

A behavioral explanation of the process of technological change in the U S aircraft manufacturing and airline industries is presented The model indicates the principal factors which influence the aircraft (airframe) manufacturers in researching developing constructing and promoting new aircraft technology and the financial requirements which determine the delivery of new aircraft to the domestic trunk airlines Following specification and calibration of the model the types and numbers of new aircraft were estimated historically for each airline s fleet Examples of possible applications of the model to forecasting an individual airline s future fleet also are provided The functional form of the model is a composite which was derived from several preceding econometric models developed on the foundations of the economics of innovation acquisition and technological change and represents an important contribution to the improved understanding of the economic and financial requirements for aircraft selection and production The model s primary application will be to forecast the future types and numbers of new aircraft required for each domestic airline s fleet A R H

N79-22065*# Massachusetts Inst of Tech Cambridge Dept of Aeronautics and Astronautics

THE IMPACT OF CHANGING TECHNOLOGY ON THE DEMAND FOR AIR TRANSPORTATION Final Report

James T Kneafsey and Nawal K Taneja 1978 27 p refs
(Grant NsG-2129)
(NASA-CR-152191) Avail NTIS HC A03/MF A01 CSCL 05C

Demand models for air transportation that are sensitive to the impact of changing technology were developed The models are responsive to potential changes in technology and to changing economic social and political factors as well In addition to anticipating the wide differences in the factors influencing the demand for long haul and short haul air travel the models were designed to clearly distinguish among the unique features of these markets J M S

N79-22066# Air Force Flight Dynamics Lab , Wright-Patterson AFB Ohio

LIGHTNING TRANSIENT RESEARCH ON AN F-111E AIRCRAFT Final Report, Jun - Dec 1976

Vernon L Mangold and Lawrence C Walko Feb 1978 105 p refs
(AD-A063765 AFFDL-TR-78-1) Avail NTIS HC A06/MF A01 CSCL 01/2

A simulated lightning test was conducted on an F-111E aircraft (S/N 67-116A) to field test improved measurement techniques and to record and evaluate induced transient voltages on selected electrical circuits to determine their susceptibility to lightning Technical improvements included (1) a pneumatic system to trigger the simulated lightning current-producing capacitor bank (2) a change in configuration of current return leads (3) specially designed breakout boxes and cables (4) a fiber optics measurement system and (5) a Tektronix transient digitizer data recording system The standard 2 x 50 microsecond current pulse was applied to the aircraft (nose-to-tail) and induced voltages were measured and recorded both in the time and frequency domains on 17 different circuits with power off in the aircraft The magnitude of the current pulse was varied from 0 5 to 5 5 kiloamperes but most measurements were made at 2 5 kiloamperes Measurements were made on flight critical circuits of the Altitude-Vertical Speed amplifiers the Yaw and Roll computers and the Roll Rate Gyro in the Feel and Trim assembly on the tail light and right and left wing position light circuits on the fuel indication circuits and on the pitot heater circuit (with and without a transient suppressor device) Power-on measurements made on four damper servo circuits resulted in substantially higher induced voltage amplitudes than with power off Changing aircraft ground points did not affect the magnitude or waveshape of induced transients GRA

N79-22067# Defence and Civil Inst of Environmental Medicine Downsview (Ontario)
TEST AND EVALUATION OF MODIFIED HIGH PERFORMANCE JET AIRCREW LIFE PRESERVER
J A Firth and J C Steffler Nov 1978 22 p refs
(AD-A063959 DCIEM-TR-78X36) Avail NTIS HC A02/MF A01 CSCL 06/7

At the request of NDHQ DCIEM evaluated several proposed Automatic Inflation Device (AID) pocket modifications for the high performance jet aircrew life preserver Two Irvin proposals and two modified pockets developed at DCIEM were compared with the existing AID pocket in terms of manual pull force and automatic inflation times Although no significant differences were noted between the four prototypes an improved AID pocket resulting from DCIEM/DAES collaboration was considered best suited for CF use Author (GRA)

N79-22068*# Systems Control, Inc West Palm Beach Fla
GENERAL AVIATION IFR OPERATIONAL PROBLEMS
Eric H Bolz and Janice E Eisele Apr 1979 218 p refs
(Contract NAS1-15313)
(NASA-CR-159022) Avail NTIS HC A10/MF A01 CSCL 17G

Operational problems of general aviation IFR operators (particularly single pilot operators) were studied Several statistical bases were assembled and utilized to identify the more serious problems and to demonstrate their magnitude These bases include official activity projections historical accident data and delay data among others The GA operating environment and cockpit environment were analyzed in detail Solutions proposed for each of the problem areas identified are based on direct consideration of currently planned enhancements to the ATC system and on a realistic assessment of the present and future limitations of general aviation avionics A coordinated set of research program is suggested which would provide the developments necessary to implement the proposed solutions A R H

N79-22069# Norwegian Defence Research Establishment Kjeller
FACTORS AFFECTING OMEGA ACCURACY
T R Larsen E R Swanson (Naval Ocean Systems Center San Diego Calif) and E V Thrane Dec 1978 32 p refs Sponsored in part by ONR
(NDRE-71 ISSN-0085-4301) Avail NTIS HC A03/MF A01

Factors affecting the navigational accuracy of Omega include system geometry phase prediction models phase measureability and signal phase repeatability A discussion of these subjects is given with emphasis on the latter topic Experimental phase data from Omega monitoring at high latitudes are presented The effects of solar X ray flares and solar proton events on Omega positional accuracy are evaluated Author

N79-22070# Old Dominion Systems Inc Gaithersburg Md
USER'S GUIDE TO DATA PREPARATION PHOTOGRAMMETRIC NAVIGATION ANALYSIS PROGRAM FOTONAP
Georg E Morduch and David A Bergeron Sep 1978 123 p
(Contract DAAK70-77-C-0254)
(AD-A064614 ETL-0174) Avail NTIS HC A06/MF A01 CSCL 17/7

This report is a user s guide for the photogrammetric navigation analysis program (generally referred to as fotonap) designed to provide the user with a detailed description of the control information needed to run fotonap Author (GRA)

N79-22071# Old Dominion Systems Inc Gaithersburg Md
KALMAN FILTERING AND SMOOTHING IN FOTONAP FOR ORBIT DETERMINATION USING GPS MEASUREMENTS Final Report
Georg E Morduch and David A Bergeron Sep 1978 139 p refs
(Contract DAAK70-77-C-0254)
(AD-A064613 ETL-0161) Avail NTIS HC A07/MF A01 CSCL 17/7

The Fotonap program has been modified to incorporate a Kalman filter and a fixed lag smoother, the capability to handle GPS measurements through the filter/smoother a Lockheed-Jacchia dynamic atmospheric model, a discretely changing atmospheric drag coefficient (drag segmentation) and the capability to accept as input to the regular Fotonap the output from the filter/smoother including the full covariance matrix The derivation of all the required equations is given in this report Updated versions of Fotonap exist for both CDC 6400 and Univac 1108 computers GRA

N79-22072# Air Force Inst of Tech Wright-Patterson AFB, Ohio School of Engineering
ERROR MODEL VERIFICATION FOR A THREE AXIS LASER GYRO STRAPDOWN INERTIAL MEASUREMENT UNIT M S Thesis
Robert S Lawrence Dec 1978 100 p refs
(AD-A064047, AFIT/GGC/EE/78-8) Avail NTIS HC A05/MF A01 CSCL 17/7

A digital data acquisition system was developed to obtain data from a Sperry laser gyroscope strapdown inertial measurement unit for error model verification The system consisted of a laboratory test set-up with the inertial measurement unit (IMU) on the Genisco rate table and input/output interfaces such that meaningful IMU sensor data was recorded on magnetic tape with absence of a microprocessor The recorded data was processed on the CDC 6600 digital computer by a specially developed program which formats the data in accordance to desired specifications The calibration sequence for error model verification was a 6-position dynamic test for the laser gyros and a 6-position static test for the accelerometers The result is a reliable and flexible system that can obtain data from the IMU in the laboratory for analysis Author (GRA)

N79-22073# Air Force Global Weather Central Offutt AFB Nebraska
ENVIRONMENTAL EFFECTS ON VLF NAVIGATION SYSTEMS, OMEGA
Edward D Beard Dec 1978 32 p refs
(AD-A063882 AFGWC-TM-78-004) Avail NTIS HC A03/MF A01 CSCL 17/7

Very Low Frequency (VLF) (3-30 khz) radio waves are exceptionally useful for long range navigation systems such as the OMEGA Anomalies in the earth s upper atmosphere specifically the ionosphere can introduce significant errors into these systems The technical memorandum describes these anomalies and introduces the products available from AFGWC which may help the navigator to better utilize the navigation system Author (GRA)

N79-22074# Naval Surface Weapons Center Dahlgren Va
AN EFFICIENT ALGORITHM FOR COMPUTING THE Q-GUIDANCE MATRIX Final Report
William L Davis Jan 1979 34 p
(AD-A064816 NSWC/DL-TR-3844) Avail NTIS HC A03/MF A01 CSCL 17/7

This paper derives a new method for computing the Q-guidance matrix This matrix is defined as the derivative with respect to position of the correlated velocity V sub C i e the velocity required to reach a given target in a specified time in an inverse-square gravitational field The method is completely analytic and yields a simple and efficient algorithm The analytic equation for the partial derivative of the horizontal component of correlated velocity with respect to range angle developed here is also of independent interest To the author s knowledge no such expression for this quantity in terms of the given conditions and the components of V sub C has been derived previously This equation in conjunction with the others given here makes it possible to compute virtually any (first order) derivative of V sub C of interest The Q-matrix algorithm is of use primarily in the analysis and modeling of guidance systems using some form of V sub G steering Author (GRA)

N79-22076*# Boeing Vertol Co Philadelphia Pa
IDENTIFICATION OF HIGH PAYOFF RESEARCH FOR MORE

EFFICIENT APPLICATOR HELICOPTERS IN AGRICULTURE AND FORESTRY
Kenneth T Waters May 1979 84 p refs
(Contract NAS2-10040)
(NASA-CR-152258 D210-11193-1) Avail NTIS HC A06/MF A01 CSCL 01C

The results of a study of the uses of helicopters in agriculture and forestry in the United States are discussed Comparisons with agricultural airplanes are made in terms of costs of aerial application to the growers An analysis of cost drivers and potential improvements to helicopters that will lower costs is presented Future trends are discussed and recommendations for research are outlined Operational safety hazards and accident records are examined and problem areas are identified Areas where research and development are needed to provide opportunities for lowering costs while increasing productivity are analyzed
Author

N79-22077# Army Aviation Engineering Flight Activity Edwards AFB Calif
ENGINEER DESIGN TEST 1, HUGHES YAH-64, ADVANCED ATTACK HELICOPTER Final Report
Richard C Tarr Robert L Stewart Ralph Woratschek and Vernon L Diekmann Sep 1978 158 p refs
(AD-A064359 USAAEFA-77-36) Avail NTIS HC A08/MF A01 CSCL 01/3

A Handling Qualities Evaluation Engineer Design Test 1 was conducted of the Hughes Helicopter Company YAH-64 advanced attack helicopter from 22 April 1978 through 1 May 1978 at Palomar Airport Carlsbad CA (elevation 320 feet) A total of 15 flights were conducted during 21 8 hours (17 4 hours productive) The objectives of the test were to reevaluate certain flight characteristics which were undesirable during Phase 1 testing and to assess the effect of design changes on aircraft handling qualities This phase of the aircraft development was not intended to address all of the undesirable flight characteristics uncovered during the Phase 1 testing Many enhancing characteristics deficiencies and shortcomings reported during the government competitive test (GCT) remain valid The YAH-64 continues to have the potential to be developed into an excellent attack helicopter
GRA

N79-22078# Effects Technology Inc Santa Barbara, Calif
DYNAMIC BEHAVIOR OF AIRCRAFT MATERIALS Final Report, 15 Feb - 31 Dec 1977
Frederic A Bick and Pamela VanBlaricum 28 Feb 1978 129 p refs
(Contract DNA001-77-C-0103)
(AD-A064592 AD-E300446 ETI-CR-78-485 DNA-4545F) Avail NTIS HC A07/MF A01 CSCL 01/3

Dynamic high strain rate loading characterization of two composite materials that are being used today in the design of military and commercial aircraft was accomplished Of particular concern was the response of such materials to nuclear blast and thermal environments Primary emphasis is placed on the graphite epoxy designated AS/3501-6 as would be used in body or wing panels Of secondary emphasis is the quartz polyimide designated F178/581 a radome material Both materials were tested quasistatically and dynamically (strain rates up to 18 inches/in/sec) and from -65F to above resin cure temperature (Cure temperatures of 350F for the graphite epoxy and 475F for the quartz polyimide) Test results indicated that both materials were stronger under dynamic loads than quasistatic loads Additionally at elevated temperatures the responses were dramatically different with the dynamic properties exhibiting little or no degradation due to temperature effects while quasistatic properties decreased significantly with temperature
Author (GRA)

N79-22079# Ballistic Research Labs Aberdeen Proving Ground Md
HIGHLY SURVIVABLE TRUSS TAIL BOOM
Thomas F Erline Nov 1978 175 p refs
(AD-A064181 AD-E430172 ARBRL-TR-02123) Avail NTIS HC A08/MF A01 CSCL 01/3

Highly redundant truss type structures which are lightweight have been analyzed by NASTRAN for replacement of the semimonocoque type tail boom Analyses show that even with massive damage criterion imposed the structure retains its integrity with level flight loads up to 130 knots The truss presents itself as a structural challenge to Soviet AA threat of the 23mm and 30mm HEI rounds Comparing the vulnerable semimonocoque configuration with the truss structure semimonocoque s vulnerable area is nearly 100% of the present area the truss has a greatly reduced vulnerable area (the joints are most vulnerable and their areas are small) The semimonocoque is blast sensitive to the AA threats mentioned because the detonation is confined and a large surface area is blown away the truss does not confine the blast thus is less sensitive Since the thin skin structure of the semimonocoque carries a great deal of load it is sensitive to crack propagation the truss is insensitive to crack propagation Since the truss can be easily designed lightweight the truss presents itself as a highly survivable competitive alternate for future Army helicopters Author (GRA)

N79-22080# Kaman Aircraft Corp Bloomfield Conn
PRELIMINARY DESIGN STUDY OF A COMPOSITE MAIN ROTOR BLADE FOR THE OH-58 HELICOPTER VOLUME 1 TRADE ANALYSIS AND PRELIMINARY DESIGN STUDY OF COMPOSITE OH-58 MAIN ROTOR BLADE Final Report, Oct 1977 - Feb 1978
Charles Hardersen and William Blackburn Sep 1978 212 p refs
(Contract DAAJ02-77-C-0075 DA Proj 1L2-62209-AH-76)
(AD-A064159 R-1532-Vol-1 USARTL-TR-78-29A) Avail NTIS HC A10/MF A01 CSCL 01/3

The objective of this program was to design a composite rotor blade for the OH-58C/A helicopter which has reduced life-cycle costs 6% improved hover performance improved reliability and maintainability reduced radar signature and increased ballistic survivability A trade-study approach was used to select the final configuration for the preliminary design phase A monolithic composite structure evolved which utilizes winding in the production of the main spar skins and the trailing edge spline The blade satisfies basic objectives using a double-tapered planform and a VR-7 airfoil Composite materials selected include S-glass E-glass and carbon graphite
GRA

N79-22081# Army Research and Technology Labs Fort Eustis Va
CH-47 HELICOPTER INTERNAL CARGO LOAD AND RESTRAINT SYSTEM MOCK-UP STUDY Technical Note, Aug 1977 - Nov 1978
John F Tansey Nov 1978 17 p
(AD-A064207 USARTL-TN-32) Avail NTIS HC A02/MF A01 CSCL 01/3

A conceptual CH-47 helicopter internal cargo load and restraint system was designed and a nonflightworthy functional mock-up of the system was constructed Mock-up components consisted of a rail/roller and support grid fore-and-aft cargo barriers and a ball transfer table The system was tested in a CH-47 and proved to be easily installed without aircraft modification Ease of use with standard Army warehouse pallets and USAF 463 pallets was demonstrated It was concluded that the system has potential for maximizing aircraft payload capabilities and improving cargo handling procedures significantly The same technology could also be made applicable to utility helicopters
Author (GRA)

N79-22082# Computer Sciences Corp Silver Spring Md System Sciences Div
THE PREDESIGN PHASE OF THE SECOND-GENERATION COMPREHENSIVE HELICOPTER ANALYSIS SYSTEM Final Report, 8 Sep 1977 - 22 May 1978
Oct 1978 396 p refs Prepared for Army Res and Technol Labs
(Contract DAAJ02-77-C-0057 DA Proj 1L2-63211-D-157)
(AD-A063921 USARTL-TR-78-41) Avail NTIS HC A17/MF A01 CSCL 01/3

This report summarizes the results of the Predesign Phase work for the Second-Generation Comprehensive Helicopter Analysis System The report includes an executive summary

summarizes a conceptual design for the System describes the System s capability provided in the First Level Release and Second Level Release discusses how the System would be used presents a summary of the plans for development of the System and presents discussions of risk considerations The objectives and life cycle of the System are presented in terms of the six life-cycle phases planning predesign development validation maintenance and user applications Predesign Phase objectives and results are discussed An overview of the System design is provided for the engineering manager the engineering user and the programmer Four major design characteristics that the System must possess for it to be universally accepted by the helicopter analysis community are discussed user orientation efficiency transportability and extendability The mathematical basis for the System is presented in terms of the types of problems to be solved by the System the finite element approach the coupling of components aerodynamic effects and numerical analysis considerations The System s software architecture is presented hierarchically GRA

N79-22083# Control Data Corp Hampton Va
PREDESIGN OF THE SECOND-GENERATION COMPREHENSIVE HELICOPTER ANALYSIS SYSTEM Final Report
Oct 1978 162 p refs
(Contract DAAJ02-77-C-0058 DA Proj 1L2-63211-D-157)
(AD-A064131 USARTL-TR-78-43) Avail NTIS
HC A08/MF A01 CSCL 01/3

This report summarizes the efforts and results of the predesign of the Second-Generation Comprehensive Helicopter Analysis System (also referred to as the System) Attention is focused on the solution to problems that are inherent in the design development maintenance validation and use of a system that satisfies the objectives and requirements set forth in the Statement of Work The objectives and design considerations are presented along with a comprehensive design that will enable the realization of all objectives through the use of dynamic component coupling techniques a comprehensive but simple user-oriented control language and an extensive library of technical modules System usage has been described in three levels Basic Intermediate and Advanced Suggested responsibilities and relationships of the various agencies during the Development Phase are presented also development schedules documentation and testing requirements are included The concept of a Baseline Review Board and its activities are offered to enhance quality assurance control Based on the results of the Predesign Phase the Second-Generation Comprehensive Helicopter Analysis System has been determined by Control Data Corporation and Kaman Aerospace Corporation to be a feasible system that will provide users with a viable vehicle for current and future endeavors in the prediction of performance stability and control acoustics loads and aeroelastic stability characteristics of rotorcraft
Author (GRA)

N79-22084# Science Applications Inc McLean Va
PREDESIGN OF THE SECOND GENERATION COMPREHENSIVE HELICOPTER ANALYSIS SYSTEM Final Report, Sep 1977 - May 1978
T Hamrick D Copeland F Tarzanin J Staley L Hunt and G Burns Dec 1978 149 p refs
(Contract DAAJ02-77-C-0059 DA Proj 1L2-63211-D-157)
(AD-A064289 USARTL-TR-78-42) Avail NTIS
HC A07/MF A01 CSCL 01/3

A predesign study was conducted for a proposed Second Generation Comprehensive Helicopter Analysis System (CHAS) A draft Type A system specification was reviewed to determine its validity for a system to analyze helicopter performance stability and control loads aeroelastic stability and acoustics using consistent technology with a capability for several levels of complexity GRA

N79-22085# Boeing Vertol Co Philadelphia Pa
OH-58 COMPOSITE MAIN ROTOR BLADES PRELIMINARY DESIGN INVESTIGATION Final Report
J S Hoffrichter Nov 1978 240 p refs
(Contract DAAJ02-77-C-0074 DA Proj 1L2-62209-AH-76)
(AD-A065010 USARTL-TR-78-27) Avail NTIS
HC A11/MF A01 CSCL 01/3

This report presents the results of a design study to replace the existing OH-58 C/A Main Rotor Blade with a Composite Rotor Blade The effort consisted of a trade study phase and a preliminary design phase The composite construction rotor blade defined in this report in whole or in part meets the defined improvement objectives in the areas of life cycle cost performance reliability and maintainability radar reflectivity and ballistic survivability GRA

N79-22086# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
PARAMETRIC ANALYSIS OF STEREOMETRIC TRACKER FOR USE IN TACTICAL AIRCRAFT M S Thesis
Kurt F Schroeder Oct 1978 115 p refs
(AD-A064688 AFIT/GEP/PH/78D-11) Avail NTIS
HC A06/MF A01 CSCL 17/8

The stereometric range finding technique is used as the basis of an airborne passive tracker An analysis of the method reveals that angular accuracy is the most critical element in this technique Range accuracy can be improved by increasing baseline separation However the vibration environment of the aircraft becomes worse as the baseline is increased The results of this investigation indicate that these vibrations counter any gain in resolution The investigation was hindered by a lack of vibrational data especially angular vibration data Author (GRA)

N79-22087*# Pennsylvania State Univ State College Applied Research Lab
THE EFFECTS OF DESIGN AND OPERATING VARIABLES ON THE RESPONSE OF AN AXIAL FLOW FAN TO INLET FLOW DISTORTIONS M S Thesis
Adam M Yocum II 14 Jun 1978 228 p refs
(Grant NsG-3031 Contract N00017-73-C-1418)
(NASA-CR-158522 ARL/TM-78-178) Avail NTIS
HC A11/MF A01 CSCL 21E

The results of a study of total pressure and velocity circumferential distortions in an axial-flow fan are presented Some of the fundamental experimental data needed to understand distorted flow phenomena as affected by design and operating variables are provided The flow through an isolated rotor was examined at various operating conditions with six different distortions and three different blade stagger angles Circumferential surveys were conducted upstream and downstream of the rotor using five-hole probes in the nonnulling mode The total pressure and axial velocity distortion data were analyzed to determine the degree of distortion attenuation as a function of blade stagger angle mean incidence angle and reduced frequency The results indicate that for the rotors tested the mean incidence or loading has very little effect on the distortion attenuation G Y

N79-22089# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
THE FLOW THROUGH LOW CAMBERED TRANSONIC TURBINE CASCADE
C H Sieverding and R Sampson *In its* VKI Short Course on Flow in Turbines Apr 1969 40 p refs

Avail NTIS HC A14/MF A01

The flow in low cambered transonic cascades with a well defined geometric throat can be reasonably well by theory The flow properties in the throat region of cascades without defined geometric throats however must be determined by experimental investigations When the cascade flow is known the losses can be calculated for the following idealized conditions (1) no shock-boundary layer interaction (2) no boundary layer separation near the trailing edge and (3) trailing edge of negligible thickness A proper loss calculation including these effects does not yet seem to exist Flow problems in transonic turbine blading are discussed for three blade configurations The cascade flow is calculated in the subsonic flow field during the transition from subsonic to supersonic flow field and for the supersonic flow field downstream of the throat Experimental and theoretical

results are compared Reattachment and separation criteria are given as well as procedures for calculating the confluence of two supersonic jet boundaries behind the trailing edge of a blade A R H

N79-22090# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
INTRODUCTION TO COOLING OF GAS TURBINE BLADES
C Liess *In its* VKI Short Course on Flow in Turbines Apr 1969 105 p refs
13-07)
Avail NTIS HC A14/MF A01

The development of heat resistant alloys and the use of various methods for cooling turbine blades and vanes to improve the gain in turbine entry temperature are reviewed The influence of turbine design and engine components on cooling problem is assessed and methods are given for calculating cooled blades The thermal and aerodynamic losses resulting from blade cooling are discussed as well as fabrication costs for cooled blades Requirements on a cooling system are described The advantages and disadvantages of internal and external liquid or air cooling are examined as well as those for a combined internal and external air cooling system A R H

N79-22091# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
AERODYNAMIC PROBLEMS IN COOLED TURBINE BLADING DESIGN FOR SMALL GAS TURBINE
J Chauvin K Papailiou and L Burrows *In its* VKI Short Course on Flow in Turbines Apr 1969 32 p refs Presented at the 32d Meeting of AGARD Propulsion and Energetics Panel on Advanced Components for Turbojet Engines Toulouse 9-13 Sep 1968
Avail NTIS HC A14/MF A01

The next generation of small gas turbines (in the 500-1000 shp range) will have to use turbine inlet temperatures of the order of 1300 C if specific fuel consumption and specific power better than those of piston engines must be reached Such temperature can be realized only if cooling of the nozzle and blades of the compressor turbine is used Air and liquid cooling are being considered Strength and space requirement lead to the use of thick blades especially at the trailing edge and having a minimum chord length of several centimeters The mass flow to handle leads to small passages height and therefore to aspect ratios of the order of 0 4 High losses are generated due to blade profile trailing edge thickness and above all secondary losses The VKI turbomachinery laboratory research in the field of blade optimization and in the analysis and reduction of secondary flows and losses is reviewed Author

N79-22092# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
AXIAL FLOW TURBINES
H Vavra *In its* VKI Short Course on Flow in Turbines Apr 1969 92 p refs
Avail NTIS HC A14/MF A01

Topics covered include fundamental flow relations (equations of motion energy and continuity) axisymmetric orthogonal coordinate systems three dimensional flows flow in turbine cascades geometry of blade profiles losses in turbine stages and off-design performance A R H

N79-22093# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
CLOSED CYCLE GAS TURBINES
1970 347 p refs Lecture held at Rhode-Saint-Genese Belgium 11-15 May 1970
(VKI-Lecture-Series-24) Avail NTIS HC A15/MF A01

The requirements of closed cycle gas turbines are discussed as well as the thermophysical properties of various working fluids Methods for calculating thermodynamic efficiency and for component design are described

N79-22094# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
CLOSED POWER CYCLES' ANALYSIS
Gianfranco Angelino *In its* Closed Cycle Gas Turbines 1970 93 p refs
Avail NTIS HC A15/MF A01

The general configuration and basic requirements of closed power cycles are discussed with emphasis on the mean density of the working fluid Methods are given for computing the thermodynamic properties of various working fluids from their volumetric behavior as well as through the principle of corresponding states Topics covered include analysis of Rankine cycles entrophy analysis organic fluid Rankine cycles single phase gas cycles (both real and ideal) nonconventional closed power cycles and configurations and carbon dioxide nonconventional closed power cycles Tables show the thermophysical properties of sodium potassium rubidium cesium mercury water carbon dioxide sulfur hexafluoride perfluoropropane dichlorodifluoromethane perfluorocyclobutane and perfluorobenzene A R H

N79-22095# Technische Universitaet Hanover (West Germany)
DYNAMIC BEHAVIOUR AND CONTROL OF SINGLE-SHAFT CLOSED-CYCLE GAS TURBINES
K Bammert and G Krey *In* Von Karman Inst for Fluid Dyn Closed Cycle Gas Turbines 1970 28 p refs

Avail NTIS HC A15/MF A01

Although a precise calculation of the dynamic behavior of a closed-cycle gas turbine involves great mathematical display sufficiently exact results can be achieved by reasonably simplifying the most difficult problems Corresponding precalculations carried out on a digital computer quickly render possible the selection of the most suitable control principle the layout of the regulating apparatuses such as valves controllers and the starting motor Such calculations also permit the optimization of the controller adjustment and the determination of stability limits of the control loop The exact solution of these points is of importance not only in regard to an undisturbed operation of the power plant but also in view of safety particularly in the case of a nuclear helium turbine Author

N79-22096# AiResearch Mfg Co Phoenix Ariz
CLOSED BRAYTON CYCLE SYSTEM OPTIMIZATION FOR UNDERSEA, TERRESTRIAL, AND SPACE APPLICATIONS
Edward A Mock *In* Von Karman Inst for Fluid Dyn Closed Cycle Gas Turbines 1970 97 p refs

Avail NTIS HC A15/MF A01

Considerable flexibility is available when adapting the closed Brayton cycle to a particular application and this same flexibility is required in the analysis procedures These procedures must accurately predict the system performance since critical design decisions are frequently based on the results Accordingly the Brayton cycle system analysis procedures are discussed to show the basis and depth of the analysis Detailed optimization studies of two cycles for the same undersea application are presented and the selection of the reference system discussed Optimization study results of several other system applications and existing hardware descriptions are included Of particular note are the results of the system studies directed toward defining the power system for the future NASA space station space base Author

N79-22097*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
DESIGN PROBLEMS OF SMALL TURBOMACHINERY
H E Rohlik *In* Von Karman Inst for Fluid Dyn Closed Cycle Gas Turbines 1970 11 p refs

Avail NTIS HC A15/MF A01 CSCL 21E

Advanced design and testing techniques developed at NASA Lewis to achieve high efficiency in small turbomachines are described Small radial and axial turbines and compressors were built for space power systems and associated studies at the Lewis Research Center A six stage axial compressor of 3 5 inches diameter and axial turbines of 5 and 8 5 inches diameter were

included Radial turbines and compressors ranged from 3 5 to 6 inches Topics discussed include maximum efficiency as a function of speed the effect of compressibility on passage size the use of quasi-orthogonals to calculate cross-channel velocity gradients a design point velocity diagram study for axial turbines and estimating off-design performance Special turbine instruments and calibration procedures were developed to test compressors and turbines, to determine Reynolds and size number effects clearance specific speed effects and compressor performance Laboratory tests conducted to study system operation and shaft and bearing motions are also reviewed A R H

N79-22098# Gutehoffnungshuette Sterkrade A G Oberhausen (West Germany)
CALCULATION AND DESIGN OF CLOSED CYCLE HELIUM TURBINES FOR HIGH TEMPERATURE REACTORS
W Twardziok *In* Von Karman Inst for Fluid Dyn Closed Cycle Gas Turbines 1970 10 p refs

Avail NTIS HC A15/MF A01

The coupling of closed cycle gas turbines with helium cooled high temperature reactors is discussed with emphasis on thermodynamics the layout of helium turbines for high output and general plant arrangement Topics covered include cycle arrangements influence of gas properties calculating the overall circuit and the determination of mass flow conditions of state and internal efficiencies From these parameters the turbines compressors and turbosets can be designed Projected development activities include the construction of test rigs and a test program for hot-gas valves and insulations A R H

N79-22099*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
PERFORMANCE OF A VORTEX-CONTROLLED DIFFUSER IN AN ANNULAR SWIRL-CAN COMBUSTOR AT INLET MACH NUMBERS UP TO 0 53
John M Smith Washington Apr 1979 17 p refs
(NASA-TP-1452 E-9832) Avail NTIS HC A02/MF A01 CSCL 21E

A short annular dump diffuser with suction stabilized vortices in the region of abrupt area change was tested with a full scale annular swirl can combustor The prediffuser area ratio was 1 4 Performance data were obtained for both isothermal and burning conditions at inlet temperatures of 589 to 895 K and pressures of 0 5 to 1 0 MPa for a range of diffuser inlet Mach numbers from 0 25 to 0 53 Suction rates were 0 to 20 percent of the total diffuser mass flow rate Diffuser effectiveness increased from 47 percent without suction to approximately 80 percent for a total suction rate of 14 percent Combustor total pressure loss for the same total suction rate was reduced from 6 8 percent without suction to 4 0 percent at an inlet Mach number of 0 40 Author

N79-22100*# Flow Research Inc Kent Wash
PROCEDURE FOR NOISE PREDICTION AND OPTIMIZATION OF ADVANCED TECHNOLOGY PROPELLERS Final Report
Wen-Huei Jou and Samuel Bernstein Apr 1979 54 p refs (Contract NAS2-9807)
(NASA-CR-3080 Rept-119) Avail NTIS HC A04/MF A01 CSCL 01C

The sound field due to a propeller operating at supersonic tip speed in a uniform flow was investigated Using the fact that the wave front in a uniform stream is a convected sphere the fundamental solution to the convected wave equation was easily obtained The Fourier coefficients of the pressure signature were obtained by a far field approximation and are expressed as an integral over the blade platform It is shown that cones of silence exist fore and aft the propeller plane The semiapex angles are shown These angles are independent of the individual Mach components such as the flight Mach number and the rotation Mach number The result is confirmed by the computation of the ray path of the emitted Mach waves The Doppler amplification factor strengthens the signal behind the propeller while it weakens that upstream J M S

N79-22101*# National Aeronautics and Space Administration Langley Research Center Hampton Va
PERFORMANCE ESTIMATION FOR A HIGHLY LOADED EIGHT-BLADE PROPELLER COMBINED WITH AN ADVANCED TECHNOLOGY TURBOSHAFT ENGINE
Shelby J Morris Jr Apr 1979 49 p refs
(NASA-TM-80075) Avail NTIS HC A03/MF A01 CSCL 21A

Performance estimation, weights and scaling laws for an eight-blade highly loaded propeller combined with an advanced turboshaft engine are presented The data are useful for planned aircraft mission studies using the turboprop propulsion system Comparisons are made between the performance of the 1990+ technology turboprop propulsion system and the performance of both a current technology turbofan and an 1990+ technology turbofan Author

N79-22102# Pratt and Whitney Aircraft Group West Palm Beach Fla Government Products Div
DESIGN, FABRICATION, AND EVALUATION OF GATORIZED (TRADE NAME) CERAMIC-WROUGHT ALLOY ATTACHMENT CONCEPTS Final Report, 1 Jul 1974 - 31 Jul 1978
S A McLeod and B H Walker Jan 1979 118 p refs
(Contract N00019-74-C-0484)
(AD-A064597 FR-9787) Avail NTIS HC A06/MF A01 CSCL 21/5

The attachment of hot pressed silicon nitride material (HPSN) ceramic blades to a wrought superalloy disk utilizing the GATORIZING forging process was developed and demonstrated for application in small gas turbine engines The development of this hybrid attachment concept consisted of fabricating, optimizing and evaluating single ceramic blade/wrought alloy attachments by spin testing at ambient and elevated temperatures The hybrid rotor concept was demonstrated by designing fabricating, and spin testing several fully-bladed hybrid rotors some containing ceramic simulated pseudoblades and others containing airfoil blades The spin testing was conducted at speeds and temperatures comparable to small gas turbine engines Author (GRA)

N79-22103# United Technologies Research Center, East Hartford Conn
NONLINEAR STOCHASTIC CONTROL DESIGN FOR GAS TURBINE ENGINES Final Technical Report, 1 Apr 1976 - 31 Mar 1978
Florence A Farrar and Gerald J Michael Jun 1978 54 p refs
(Contract N00014-76-C-0710 RR0141184)
(AD-A065075 UTRC/R78-942577-13 ONR-CR-215-247-2F) Avail NTIS HC A04/MF A01 CSCL 21/5

Synthesis procedures for nonlinear stochastic feedback control of gas turbine engines were developed and evaluated Modern estimation and control procedures based upon separating the stochastic and deterministic aspects of the control problem were employed The resulting closed-loop control consists of nonlinear deterministic feedback control logic designed using piecewise-linear/piecewise-optimal techniques, and an estimator designed using nonlinear filtering logic Engine variables estimated from noise-corrupted measurements are fed back through the deterministic control logic to generate commanded inputs to the engine Mode-switching logic was developed to provide smooth transition between small-signal regulation and large-signal transient modes of estimator/controller operation GRA

N79-22104# Pratt and Whitney Aircraft Group West Palm Beach Fla Government Products Div
LO-FREQUENCY AUGMENTOR INSTABILITY STUDY Final Report, 1 Mar 1976 - 30 Jul 1978
P Z Russell and G Brant 15 Dec 1978 230 p refs
(Contract F33615-76-C-2024)
(AD-A065144, PWA-FR-10397 AFAPL-TR-78-82) Avail NTIS HC A11/MF A01 CSCL 21/5

With the advent of the mixed-flow afterburner in turbofan engines a type of low-frequency instability known as rumble

became a serious problem Rumble occurs mainly at high fuel-air ratios and at flight Mach numbers and altitudes where low duct inlet air temperatures and pressures exist Cut and try methods of solution during engine development have been partially successful but very expensive To aid the development engineer in designing rumble-free afterburners an analytical model has been formed The model was evolved in conjunction with and checked by two experimental programs Rumble mechanisms investigated early in this study involved system airflow dynamics combustion efficiency oscillations, fuel vaporization and recirculation wake energy The model was then refined and extended to include the mixed flow experienced in a turbofan augmentor Predictions were made for the effects of altitude fan stream fuel-air ratio, fan stream temperature core stream fuel-air ratio and fan duct pressure loss The major conclusion from the modeling effort was that the efficiency falloff in the fan stream at high fuel-air ratio causes rumble This was verified with engine altitude tests at NASA Lewis Research Center with several augmentor configurations These tests included heat addition to the fan stream fuel-air distribution changes and spraybar to flameholder length variation The basic formulation of the model the mixed flow augmentor model predictions and the experimental programs are discussed Author (GRA)

N79-22105# General Electric Co Cincinnati Ohio Aircraft Engine Group
ADVANCED COMPOSITE ENGINE ROTOR DESIGN Final Technical Report, Oct 1977 - Mar 1978
Richard Ravenhall, Robert Strabrylla, and Lewis Stoffer Oct 1978 117 p
(Contract F33615-77-C-5201)
(AD-A063843, R78AEG333 AFML-TR-78-134) Avail NTIS HC A06/MF A01 CSCL 21/5

This report describes the results of an advanced composite-rotor mechanical-design-feasibility study program Four advanced composite fan-rotor concepts and one composite reinforced compressor-rotor concept were evolved and evaluated during this study One particular fan concept titled pinned-blade/hoop rotor received extended evaluation because it allowed the replacement of blades and showed a significant weight and cost advantage over the metal counterpart This concept was applied to both a subsonic-flight engine and a supersonic-flight engine for potential future development Author (GRA)

N79-22106# General Electric Co Cincinnati Ohio Aircraft Engine Group
REGRESSION SIMULATION OF TURBINE ENGINE PERFORMANCE/AIRCRAFT REGRESSION MODEL Final Technical Report, Sep 1977 - Jul 1978
Warren Joy and Donald E Uehling Nov 1978 76 p refs
(Contract F33615-77-C-2108 AF Proj 3066)
(AD-A063975, R78AEG445 AFAPL-TR-78-76) Avail NTIS HC A05/MF A01 CSCL 21/5

The Aircraft Regression Model (ARM) Task has explored modification of the Boeing Turbine Engine Variable Cycle Selection/Airplane Response Engine Selection(TEVCS/ARES) procedures by decoupling the representation of specific propulsion systems and the detailed mission definitions from the overall surface fit representations of the aircraft Detailed comparisons between the RSTEP/ARM techniques developed herein and another available technique for aircraft/engine design refinement are provided as the principal result of this program All objectives of the RSTEP/ARM effort were attained A simplified mission performance computer program was developed and tested in the evaluation of two engine cycle concepts one a turbojet and one a turbofan The program was simplified by using regression models for airframe geometry weights and drags The program is currently operational in both the Air Force and at two industry sites GRA

N79-22107# AiResearch Mfg Co Phoenix Ariz
RESEARCH AND EVALUATION PROGRAM ON A BACKUP CONTROL SYSTEM FOR GAS TURBINE ENGINES Final Report, Oct 1977 - Aug 1978
Trevor G Sutton Sep 1978 38 p refs
(Contract DAAG39-77-C-0186)
(AD-A064326 AiResearch-41-2111 HDL-CR-78-186-1) Avail NTIS HC A03/MF A01 CSCL 21/5

This report presents the results of a program conducted by AiResearch and funded by Harry Diamond Laboratories to investigate backup control systems for gas turbine engines which could be used in military ground vehicles The program addressed the control system requirements that are deemed necessary to provide a military gas turbine powered vehicle with battlefield survivability and minimal restriction on the capability of completing the vehicle mission This study showed that a parallel dissimilar technology backup control was the desirable approach and that fluidics was the ideal technology to perform this function due to its low cost reliability immunity to radiation and ability to perform computation and logic commensurate with the requirements of achieving mission completion with no degradation in the vehicle s battlefield survivability Author (GRA)

N79-22108# Panametrics Inc Waltham Mass
ADVANCED TECHNOLOGY FUEL MASS FLOWMETER Final Report, Jun 1977 - Jun 1978
Lawrence C Lynnworth Norman E Pedersen, John L Seger and James E Bradshaw Oct 1978 53 p refs
(Contract DAAJ02-76-C-0030)
(AD-A063963 USARTL-TR-78-45 Rept-138) Avail NTIS HC A04/MF A01 CSCL 21/4

The fuel mass flowmeter system demonstrated in a previous Army program consisting of an ultrasonic flow velocimeter and a capacitance-type densitometer was adapted to T-700 gas turbine engine requirements Mechanical adaptations included the reduction in size and weight of the flow cell to fit the configuration and mounting constraints of a T-700 engine Electronic developments included repackaging into a portable field-type case configuration switching and digital delay equalizers and the substitution of a microprocessor for a previously used calculator chip resulting in a choice of response times or integration times selectable from approximately 50s down to approximately 0 5s GRA

N79-22109*# Scott Environmental Technology Inc Plumsteadville Pa
F-100 TURBINE ENGINE AFTERBURNER EMISSION TESTS Final Report, Nov 1976 - Dec 1977
Anthony F Sousa and Harold A Scott Jr Sep 1978 90 p refs
(Contract F08635-77-C-0216 AF Proj 2103)
(AD-A063789 SET-1628-01-1177 CEEDO-TR-78-54) Avail NTIS HC A05/MF A01 CSCL 21/2

The afterburner exhaust emissions from three F-100-P-100 engines were measured Emission rates of hydrocarbons carbon monoxide and oxides of nitrogen were calculated Smoke numbers were also measured Author (GRA)

N79-22110# Teledyne Ryan Aeronautical Co San Diego Calif
RPV ELECTRIC POWER SYSTEM STUDY PHASE 2 HOT BENCH MOCKUP DEVELOPMENT Final Technical Report, 1 May 1978 - 31 Aug 1978
Frederic L Miller and Lou Pico Nov 1978 100 p
(Contract F33615-76-C-2069 AF Proj 3145)
(AD-A065008 TRA-29318-08 AFAPL-TR-78-93) Avail NTIS HC A05/MF A01 CSCL 01/3

The RPV Electric Power Study explores ways for exploiting technology and resolving critical issues affecting the electrical subsystems of remotely piloted vehicles The objective is to define electrical components and system concepts that offer significant cost weight and performance improvements over present day systems Phase I is an assessment of technologies capable of benefitting RPV electrical systems Phase II develops a plan to transfer viable technologies into RPV systems The Phase II approach is to first develop a complete picture of the needs requirements and constraints on a laboratory hot bench mockup After considering concept alternatives and related design factors a modular concept is selected that is adaptable to all classes of RPV Preliminary designs of a mockup for each of the four classes of RPV are described that is Advanced multi-mission RPV High-altitude long endurance RPV Mini RPV and Tactical expendable drone system (TEDS) A mockup development plan

is presented for each RPV class including a schedule budgetary estimate of labor and material costs list of components and a list of manufacturers capable of developing those items requiring development Also included is a guide for developing test programs for RPV electrical systems Author (GRA)

N79-22111# National Technical Information Service Springfield Va

TURBINE BLADES EROSION AND CORROSION CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Feb 1979

Guy E Habercom Jr Mar 1979 171 p Supersedes NTIS/PS-78/0144 NTIS/PS-77/0086 NTIS/PS-76/0081 NTIS/PS-75/127

(NTIS/PS-79/0148/1 NTIS/PS-78/0144 NTIS/PS-77/0086 NTIS/PS-76/0081 NTIS/PS-75/127) Avail NTIS HC $28 00/MF $28 00 CSCL 21E

These Government-sponsored research reports describe sources of erosion/corrosion of turbine blades and suggest methods to eliminate or alleviate the problems This updated bibliography contains 165 abstracts 26 of which are new entries to the previous edition GRA

N79-22112# National Technical Information Service Springfield Va

TURBINE BLADES EROSION AND CORROSION CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Feb 1979

Guy E Habercom Jr Mar 1979 201 p Supersedes NTIS/PS-78/0145 NTIS/PS-77/0087 NTIS/PS-76/0082

(NTIS/PS-79/0149/9 NTIS/PS-78/0145 NTIS/PS-77/0087 NTIS/PS-76/0082) Avail NTIS HC $28 00/MF $28 00 CSCL 21E

These reports gathered in a worldwide literature survey describe sources of erosion/corrosion of turbine blades and suggest methods to eliminate or alleviate the problems This updated bibliography contains 195 abstracts 36 of which are new entries to the previous edition GRA

N79-22113*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif

IMPORTANT FACTORS IN THE MAXIMUM LIKELIHOOD ANALYSIS OF FLIGHT TEST MANEUVERS

Kenneth W Iliff Richard E Maine and T D Montgomery Apr 1979 44 p refs

(NASA-TP-1459 H-1076) Avail NTIS HC A03/MF A01 CSCL 01C

The information presented is based on the experience in the past 12 years at the NASA Dryden Flight Research Center of estimating stability and control derivatives from over 3500 maneuvers from 32 aircraft The overall approach to the analysis of dynamic flight test data is outlined General requirements for data and instrumentation are discussed and several examples of the types of problems that may be encountered are presented SES

N79-22114# Bendix Corp Teterboro N J Flight Systems Div

ADVANCED FLIGHT CONTROL ACTUATION SYSTEM (AFCAS-E/P) FEASIBILITY INVESTIGATION OF AN ELECTRO/PNEUMATIC DUAL POWER DRIVEN CONCEPT Final Report, Mar 1977 - May 1978

R E Feucht Rex W Presley Philip Forman and Richard Krehely Jun 1978 121 p

(Contract N62269-77-C-0171)

(AD-A063992 FSD-7411-78 05 NADC-77001-60) Avail NTIS HC A06/MF A01 CSCL 01/3

This is a report of design study on Dual-Mode Dynavector Actuator for use as control-surface actuator on aircraft Actuator operates on pneumatic power and /or electric power Operation within specifications continues despite loss of either electric or pneumatic power providing survivability feature for aircraft Author (GRA)

N79-22115# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering

APPLICATION OF MODEL ALGORITHMIC CONTROL TO A LIGHTLY DAMPED SINGLE INPUT SINGLE OUTPUT SYSTEM M S Thesis

Howard J Colson Jr Dec 1978 112 p refs

(AD-A064222 AFIT/GE/EE/78-21) Avail NTIS HC A06/MF A01 CSCL 01/3

A new digital control technique called Model Algorithmic Control (MAC) was applied to a single-input single-output model containing complex eigenvalues The MAC algorithm developed was a simplified version of the algorithm used by ADERSA/ GERBIOS Corporation (France) in a complete computer program designated IDCOM (Identification and Command) A second-order model based on the dominant eigenvalues of the B-52E Flutter Mode was selected as the hypothetical system to be controlled Data were obtained for various selections of control parameters in the implementing program then a study was made of the controlling program s robustness to eigenvalue changes The second-order model was subsequently expanded to a third-order then a fourth-order model while maintaining the previously found optimum control parameters Results obtained indicated that the robustness exhibited in the MAC concept as implemented in IDCOM is not attributed to the impulse response prediction technique but rather must be attributed to the particular control algorithm used in IDCOM Therefore before conclusive results could be obtained for robustness and higher-order model studies further refinement of the simplified MAC algorithm used in this thesis was necessary A revision to the implementing program was begun but due to time considerations was not completed Author (GRA)

N79-22116# National Aviation Facilities Experimental Center Atlantic City N J

EVALUATION OF A REMOTE TONE SIGNALING CONTROL/ MONITOR SYSTEM AS LIGHTNING/TRANSIENT PROTECTION FOR SOLID STATE INSTRUMENT LANDING SYSTEMS Final Report, Aug 1976 - Apr 1978

James R Branstetter Jan 1979 21 p refs

(FAA Proj 071-713-000)

(AD-A063766 FAA-NA-78-35 FAA-RD-78-149) Avail NTIS HC A02/MF A01 CSCL 17/7

A new technique in remote control and monitoring of a solid-state instrument landing system was evaluated at the National Aviation Facilities Experimental Center intended as a solution to problems caused by lightning and transients on phone lines and buried cables The findings show the system effectively reduces or eliminates false transmitter cycling erroneous status indications and damage to the ILS equipment Author

N79-22117# ARO Inc Arnold Air Force Station Tenn

CALIBRATION OF THE AEDC-PWT 16-FOOT TRANSONIC TUNNEL AERODYNAMIC TEST SECTION AT VARIOUS REYNOLDS NUMBERS Final Report, Apr 1976 - Jun 1978

F M Jackson III Feb 1979 179 p refs

(AD-A065112 AEDC-TR-78-60) Avail NTIS HC A09/MF A01

Tests were conducted in the AEDC Propulsion Wind Tunnel (16T) to determine the tunnel test section Mach number distributions and calibration at various Reynolds numbers Two separate test entries were made Collectively the calibration was conducted at Mach numbers from 0 2 to 1 6 and at Reynolds numbers from 500 000/ft to 6 million/ft The calibration was conducted with the aerodynamic test section (Test Section 2) using a centerline pipe and/or wall pressure orifices to define the Mach number distributions A quantitative evaluation of the effects of tunnel pressure ratio, test section wall angle and Reynolds number on the tunnel Mach number distributions and calibration was accomplished Results indicate that good quality Mach number distributions are obtained for both zero and the optimum wall angle schedule To obtain the maximum accuracy the Tunnel 16T calibration must be defined as a function of test section wall angle Reynolds number and Mach number Comparison of this calibration with previous calibration results indicates that a revision in the tunnel calibration used for operations is desirable Analytical expressions which represent

the tunnel calibration at various test conditions were developed for use during Tunnel 16T operations GRA

N79-22118# Air Force Human Resources Lab Brooks AFB Tex
ADVANCED SIMULATOR FOR PILOT TRAINING (ASPT) AERIAL REFUELING VISUAL SIMULATION-ENGINEERING Final Report, Sep 1977 - Feb 1978
Eric G Monroe Kent I Mehrer Richard L Engel Samuel Hannan James McHugh George Turnage and David R Lee Sep 1978 43 p
(AF Proj 1123)
(AD-A063283 AFHRL-TR-78-51) Avail NTIS HC A03/MF A01 CSCL 05/9

This report documents the engineering modifications made to the Advanced Simulator for Pilot Training (ASPT) to expand its capability to include aerial refueling simulation These modifications include the generation of a number of KC-135 tanker models (in various levels of image detail) refueling boom and director lights The existing variable/slewable field-of-view program was modified to generate multiple window configurations The on-line programs were amended to provide boom dynamics operational director lights and tanker flow field effects Performance measurement techniques and a dynamic graphics display were programmed to provide an adequate means of assessing and monitoring pilot performance Author (GRA)

N79-22119# Logicon Inc San Diego Calif
DEFINITION OF REQUIREMENTS FOR A PERFORMANCE MEASUREMENT SYSTEM FOR C-5 AIRCREW MEMBERS Final Report, Jun 1976 - Mar 1978
Jay R Swink Edward A Butler Harry E Lankford Ralph M Miller and Hal Watkins Oct 1978 76 p
(Contract F33615-76-C-0056)
(AD-A063282, AFHRL-TR-78-54) Avail NTIS HC A05/MF A01 CSCL 05/9

This study identified and defined C-5 aircrew tasks and performances essential to the effective operation of the aircraft on a typical representative mission It described present capabilities of C-5 simulators to determine how these capabilities might be implemented or augmented for measuring crew performance The results of the above efforts were synthesized into a description of the requirements for a C-5 aircrew performance measurement subsystem The study also identified the applicability of these C-5 simulator performance measures to the airborne environment The capabilities of the C-5 aircraft systems to provide necessary data are described and the results are synthesized into a functional description for a C-5 inflight performance measurement system Author (GRA)

N79-22120# General Accounting Office Washington D C Logistics and Communications Div
DOD'S COMMENDABLE INITIAL EFFORTS TO SOLVE LAND USE PROBLEMS AROUND AIRFIELDS
Jan 1979 36 p
(PB-291617/9 LCD-78-341) Avail NTIS HC A03/MF A01 CSCL 13B

A program for achieving compatible land uses around military airfields is reviewed It is suggested that the airfield studies where operational changes have occurred be revised to identify more accurate and current noise zones GRA

N79-22199*# National Aeronautics and Space Administration Langley Research Center Hampton Va
CARBON FIBERS AND COMPOSITES
Richard A Pride *In its* Carbon Fiber Risk Anal 1979 p 29-40

Avail NTIS HC A11/MF A01 CSCL 11D

The basic nature of composite materials is considered Carbon fiber composites and their area of current and planned application in civil aircraft are discussed specifically within the framework of the various aspects of risk analysis J M S

N79-22200*# National Aeronautics and Space Administration Langley Research Center Hampton, Va
SOURCE OF RELEASED CARBON FIBERS
Vernon L Bell *In its* Carbon Fiber Risk Anal 1979 p 41-71
Avail NTIS HC A11/MF A01 CSCL 11D

The potential for the release of carbon fibers from aircraft crashes/fires is addressed Simulation of the conditions of aircraft crash fires in order to predict the quantities and forms of fibrous materials which might be released from civilian aircraft crashes/fires is considered Figures are presented which describe some typical fiber release test activities together with some very preliminary results of those activities The state of the art of carbon fiber release is summarized as well as some of the uncertainties concerning accidental fiber release J M S

N79-22204*# National Aeronautics and Space Administration Langley Research Center Hampton Va
END-TO-END TESTING
Richard A Pride *In its* Carbon Fiber Risk Anal 1979 p 125-139

Avail NTIS HC A11/MF A01 CSCL 11D

The principle objective of the kinds of demonstration tests that are discussed is to try to verify whether or not carbon fibers that are released by burning composite parts in an aircraft-fuel fires can produce failures in electrical equipment A secondary objective discussed is to experimentally validate the analytical models for some of the key elements in the risk analysis The approach to this demonstration testing is twofold limited end-to-end test are to be conducted in a shock tube and planning for some large outdoor burn tests is being done G Y

N79-22207*# ORI Inc Silver Spring Md
AN ASSESSMENT OF LOCAL RISK
Leon Pocinki *In* NASA Langley Res Center Carbon Fiber Risk Anal 1979 p 173-198

Avail NTIS HC A11/MF A01 CSCL 11D

A status report is presented on the assessment of the risk at Washington National Airport and the surrounding Washington D C area associated with commercial operations of aircraft with graphite fiber composite in their structures The presentation is outlined as follows (1) overall strategy (2) need for individual airport results (3) airport-metro area model - submodels method assumptions and data and (4) preliminary results for National Airport - D C area G Y

N79-22208*# Little (Arthur D) Inc Washington D C
AN ASSESSMENT OF NATIONAL RISK GENERAL CONCEPTS AND OVERALL APPROACH
Ashok Kalelkar *In* NASA Langley Res Center Carbon Fiber Risk Anal 1979 p 199-234

Avail NTIS HC A11/MF A01 CSCL 11D

The analysis of risk presented by carbon fiber utilization in commercial aviation is reported The discussion is presented in three parts (1) general concepts (2) overall approach and (3) risk evaluation and perspective G Y

N79-22209*# National Aeronautics and Space Administration Langley Research Center Hampton Va
CARBON FIBER RISK ANALYSIS CONCLUSIONS
Robert J Huston *In its* Carbon Fiber Risk Anal 1979 p 235-248

Avail NTIS HC A11/MF A01 CSCL 11D

It was concluded that preliminary estimates indicate that the public risk due to accidental release of carbon fiber from air transport aircraft is small It was also concluded that further work is required to increase confidence in these estimates G Y

N79-22215# Rockwell International Corp Columbus, Ohio Aircraft Div
EVALUATION OF COMPOSITE WING FOR XFV-12A AIRPLANE, APPENDIX C Final Report, Aug - Sep 1978
13 Oct 1978 65 p
(Contract N62269-74-C-0577)
(AD-A063848 NADC-77183-30-APP-C) Avail NTIS HC A04/MF A01 CSCL 11/4

This Appendix prepared as a supplement to final report NADC-77183-30 dated December 1976 presents results of static and fatigue tests of a graphite/epoxy wing box structure designed and fabricated by the Columbus Aircraft Division (CAD) of Rockwell International Corporation under contract N62269-74-C-0577 These tests were conducted by the Navy at the Naval Air Development Center Warminster Pa during the period August-September 1978 Static loads to 150% of design limit load for the critical carrier based landing condition were applied to the composite wing box structure followed by a two lifetime fatigue spectrum loading with no evidence of structural damage or deformation Descriptions of the test setup applied loadings strain gage data deflection transducer data and comparisons of predicted vs recorded strain and deflection measurements are presented Author (GRA)

N79-22490# Borg-Warner Corp , Des Plaines Ill
SAMPLE CALCULATION 4 PHI = 9 DEG 57
S Gopalakrishnan *In* Von Karman Inst for Fluid Dyn Transonic Flows in Turbomachinery Vol 2 1973 2 p

Avail NTIS HC A09/MF A01
The performance of the cascade at supersonic transonic and supersonic inlet Mach numbers was studied An inlet tangential velocity upstream tangential velocity and flow angle and a backpressure were obtained S E S

N79-22508# Creare Inc Hanover N H
THE FLUID DYNAMIC DESIGN OF ADVANCED CENTRIFUGAL COMPRESSORS
Robert C Dean Jr *In* Von Karman Inst for Fluid Dyn Advanced Radial Compressors 1974 99 p refs

Avail NTIS HC A05/MF A01
The flow models and aerodynamic design systems developed for the centrifugal compressor are described Some evidence of the success and failings of this approach is given Important unresolved fluid dynamic problems now barring access to ultimate centifugal compressor performance are defined Author

N79-22518*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
OPERATING CHARACTERISTICS OF A CANTILEVER-MOUNTED RESILIENT-PAD GAS-LUBRICATED THRUST BEARING
Zolton N Nemeth Washington Apr 1979 30 p refs
(NASA-TP-1438 E-9815) Avail NTIS HC A03/MF A01 CSCL 13I
A resilient-pad gas thrust bearing consisting of pads mounted on cantilever beams was tested to determine its operating characteristic The bearing was run at a thrust load of 74 newtons to a speed of 17000 rpm The pad film thickness and bearing friction torque were measured and compared with theory The measured film thickness was less than that predicted by theory The bearing friction torque was greater than that predicted by theory Author

N79-22522# Sikorsky Aircraft Stratford Conn
ADVANCED COUPLING DEVELOPMENT PROGRAM Final Report, 15 Jun 1974 - 30 Oct 1977
Robert A Stone Oct 1978 138 p
(Contract DAAJ02-74-C-0054)
(AD-A064296, SER-510004, USARTL-TR-78-40) Avail NTIS HC A07/MF A01 CSCL 01/3
This report documents a four-phase effort in the development of an advanced technology coupling A coupling survey(design and operational requirements definition, conceptual and detail design, fabrication static testing and dynamic testing) was conducted Two concepts out of seven developed in the program were chosen for fabrication and testing One coupling a composite flexure element design, successfully completed a basic dynamic performance test and demonstrated superior operational capability to a stainless steel counterpart Author (GRA)

N79-22523# SKF Industries, Inc King of Prussia Pa
USER'S MANUAL FOR STEADY STATE AND TRANSIENT THERMAL ANALYSIS OF A SHAFT-BEARING SYSTEM (SHABERTH) Final Report, Sep 1977 - Apr 1978
William J Crecelius Nov 1978 174 p
(Contract DAAD05-74-C-0747)
(AD-A064150, AD-E430167, ARBRL-CR-00386) Avail NTIS HC A08/MF A01 CSCL 09/2
Predicting the performance of helicopter engine and transmission bearings following loss of normal circulating lubrication is an important part of an aircraft vulnerability estimate The program SHABERTH was developed to provide the means of estimating the mechanical and thermal state of critical components within a shaft-bearing-housing drive system, first in the normal service (steady state) lubricated condition and second in the oil-starved (transient) condition The program is installed on the BRL Univac 1108 system and is used primarily to predict time-to-failure and failure mode after oil starvation, however, it will at the same time predict thermal dams, critical clearances and other significant behavioral features of the system under treatment, for both normal and dry operation The program is being used for problems concerning domestic developmental aircraft and non-domestic aircraft for which no physical test data or hardware are available Author (GRA)

N79-22540*# National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston Tex
HYDRAZINE MONOPROPELLANT RECIPROCATING ENGINE DEVELOPMENT
James W Akkerman *In its* The 13th Aerospace Mech Symp 1979 p 1-14
Avail NTIS HC A13/MF A01 CSCL 21G
A hydrazine fueled piston engine for providing 11 2 kW was developed to satisfy the need for an efficient power supply in the range from 3 7 to 74 6 kW where existing nonair-breathing power supplies such as fuel cells or turbines are inappropriate The engine was developed for an aircraft to fly to 21 3 km and above and cruise for extended periods A remotely piloted aircraft and the associated flight control techniques for this application were designed The engine is geared down internally (2 1) to accommodate a 1 8 m diameter propeller An alternator is included to provide electrical power The pusher-type engine is mounted onto the aft closure of the fuel tank which also provides mounting for all other propulsion equipment About 20 hrs of run time demonstrated good efficiency and adequate life One flight test to 6 1 km was made using the engine with a small fixed-pitch four-bladed propeller The test was successful in demonstrating operational characteristics and future potential J M S

N79-22541*# Sikorsky Aircraft, Stratford Conn
DESIGN AND DEVELOPMENT OF A MOTION COMPENSATOR FOR THE RSRA MAIN ROTOR CONTROL
P Jeffrey and R Huber *In* NASA Johnson Space Center The 13th Aerospace Mech Symp 1979 p 15-25 refs

Avail NTIS HC A13/MF A01 CSCL 01C
The RSRA an experimental helicopter is equipped with an active isolation system that allows the transmission to move relative to the fuselage The purpose of the motion compensator is to prevent these motions from introducing unwanted signals to the main rotor control A motion compensator concept was developed that has six-degree-of-freedom capability The mechanism was implemented on RSRA and its performance verified by ground and flight tests J M S

N79-22637# Chrysler Corp , New Orleans La Defense-Space Div
DEVELOPMENT OF A NICAD BATTERY INTERFACE UNIT Final Report, Jul 1976 - May 1978
Earnest Stephens Dec 1978 75 p
(Contract DAAJ02-76-C-0054)
(AD-A064290 USARTL-TR-78-47) Avail NTIS HC A04/MF A01 CSCL 10/3
This report describes the effort to develop and test a Battery Interface Unit (BIU) for use on Army aircraft The BIU provides

a means to charge and monitor the status of nickel-cadmium batteries and is an onboard unit that can be readily integrated with the existing aircraft electrical system The initial portion of the multitask program involved definition of candidate approaches analysis to select the optimum approach and design of a system to implement the multilevel constant current approach selected as optimum Six BIUs were then fabricated, three to operate with an AC input and three to operate from a DC input, they were subjected to a variety of performance and environmental tests to demonstrate performance The objectives of the program were to develop a system that would reduce battery maintenance cost increase the useful life of NICAD batteries and eliminate battery-related safety hazards The results of the program clearly demonstrated that a BIU can be built which meets these objectives and which can be packaged within weight and volume limits compatible with onboard aircraft usage Author (GRA)

N79-22706*# Dayton Univ Research Inst Ohio
FROST FORMATION ON AN AIRFOIL A MATHEMATICAL MODEL 1 Final Report
Mark Dietenberger (Dayton Univ Research Inst Ohio) Prem Kumar (Dayton Univ Research Inst Ohio) and James Luers (Dayton Univ Research Inst Ohio) Apr 1979 80 p refs (Contract NAS8-31294)
(NASA-CR-3129 UDR-TR-78-123) Avail NTIS HC A05/MF A01 CSCL 04B

A computer model to predict the frost formation process on a flat plate was developed for application to most environmental conditions under which frost occurs The model was analytically based on a generalized frost thermal conductivity expression on frost density and thickness rate equations and on modified heat and mass transfer coefficients designed to fit the available experimental data The broad experimental ranges reflected by the extremes in ambient humidities wall temperatures and convective flow properties in the various publications which were examined served to severely test the flexibility of the model An efficient numerical integration scheme was developed to solve for the frost surface temperature density and thickness under the changing environmental conditions The comparison of results with experimental data was very encouraging Author

N79-22783*# National Aeronautics and Space Administration Langley Research Center Hampton Va
EVALUATION APPLIED TO RELIABILITY ANALYSIS OF RECONFIGURABLE, HIGHLY RELIABLE, FAULT-TOLERANT, COMPUTING SYSTEMS
Gerard E Migneault Apr 1979 13 p refs
(NASA-TM-80090) Avail NTIS HC A02/MF A01 CSCL 09B

Emulation techniques are proposed as a solution to a difficulty arising in the analysis of the reliability of highly reliable computer systems for future commercial aircraft The difficulty viz the lack of credible precision in reliability estimates obtained by analytical modeling techniques are established The difficulty is shown to be an unavoidable consequence of (1) a high reliability requirement so demanding as to make system evaluation by use testing infeasible (2) a complex system design technique fault tolerance (3) system reliability dominated by errors due to flaws in the system definition and (4) elaborate analytical modeling techniques whose precision outputs are quite sensitive to errors of approximation in their input data The technique of emulation is described indicating how its input is a simple description of the logical structure of a system and its output is the consequent behavior The use of emulation techniques is discussed for pseudo-testing systems to evaluate bounds on the parameter values needed for the analytical techniques S E S

N79-22849*# National Aeronautics and Space Administration Langley Research Center Hampton Va
A CORRELATION OF MIXING NOISE FROM COANNULAR JETS WITH INVERTED FLOW PROFILES
S Paul Pao Apr 1979 127 p refs
(NASA-TP-1301 L-12155) Avail NTIS HC A07/MF A01 CSCL 20A

Data are correlated for jet mixing noise from coannular jets with inverted flow velocity profiles The acoustic performance of coannular jets is compared to the performance of a hypothetical single jet with the same total mass flow thrust and total enthalpy flow as the coannular jet The study shows that coannular jets with velocity ratios greater than 1 2 produce less noise than their corresponding equivalent tests and that optimum noise reduction of coannular jets in the data set occurs within a range of equivalent velocities between 500 and 700 meters per second and velocity ratios between 1 6 and 2 3 The maximum sound power reduction is found to be about 4 decibels Directivity indices and a special set of spectral curves were developed to describe the characteristic double peak spectra of coannular jet noise The temperature ratio between the inner and outer streams was not found to be important in this acoustic correlation However the mean temperature effect was included in the computations of sound pressure levels L S

N79-22851# Federal Aviation Administration Washington D C Office of Environmental Quality
INTEGRATED NOISE MODEL
Apr 1978 16 p Original contains color illustrations
Avail NTIS HC A02/MF A01

A valuable noise-simulation computer-based tool for describing and defining the impact of aircraft noise around an airport is described The integrated noise model (INM) which is useful in assessing actual or predicted airport noise impacts takes into account all pertinent impact parameters including types and numbers of aircraft operating at the airport flight tracks operating procedures and time of day of aircraft operations The capabilities and characteristics of the INM are discussed in order to provide a better understanding of aircraft noise the need for the INM and its potential applications A R H

N79-22854# Lockheed-Georgia Co Marietta
THE GENERATION, RADIATION AND PREDICTION OF SUPERSONIC JET NOISE VOLUME 2, APPENDIX COMPUTER PROGRAM LISTING Final Technical Report, 1 Dec 1975 - 1 Sep 1978
B J Tester P J Morris H K Tanna and D F Blakney Oct 1978 134 p refs
(Contract F33615-76-C-2021)
(AD-A064685 LG78ER0262-Vol-2 AFAPL-TR-78-85-Vol-2) Avail NTIS HC A07/MF A01 CSCL 20/1

This appendix volume presents a complete listing of the unified jet noise prediction computer program (UNIJET) developed to predict the total noise from a subsonic or supersonic jet under static conditions In addition a listing of the computer program (called INTEG) to predict absolute turbulent mixing noise levels at 90 deg to the jet axis using laser velocimeter turbulence measurement is also given A detailed description of these two programs in the form of a user s guide is given in the main volume of this report Author (GRA)

N79-22882# HTL Industries Inc Santa Ana Calif K West Div
APPLICABILITY OF FIBER OPTICS TO AIRCRAFT FIRE DETECTION SYSTEMS Final Report, 15 May - 15 Aug 1978
Richard D McGunigle Howard W Jackson and Robert R Beavers Oct 1978 73 p refs
(Contract F33615-75-C-2030 AF Proj 3048)
(AD-A063974 HTL-K-West-D-1530 AFAPL-TR-78-84) Avail NTIS HC A04/MF A01 CSCL 20/6

A review of the state-of-the-art in ultra-violet conducting fiber optics and related system components was conducted with the objective of evaluating their potential applicability to solar blind UV fire detection systems From this basis conceptual systems were developed and analyzed to assess the potential payoff of incorporating optical enhancement to improve the performance and reduce the initial and life cycle cost size and weight of such systems and to effect detector circuit simplification and improvement in system reliability Author (GRA)

N79-22957* National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

AMES RESEARCH CENTER PUBLICATIONS, 1977
Apr 1979 123 p
(NASA-TM-78514 A-7704) Avail NTIS HC A06/MF A01 CSCL 05B

This bibliography lists 786 formal NASA publications journal articles books chapters of books patents and contractor reports which appeared during 1977 or which were not included in previous annual bibliographies Citations are arranged by directorate type of publication and author Each NASA report is identified by a technical report and accession number to facilitate ordering An author index is provided A R H

N79-22964# RAND Corp Santa Monica Calif
AN APPRAISAL OF MODELS USED IN LIFE CYCLE COST ESTIMATION FOR USAF AIRCRAFT SYSTEMS Interim Report
Kenneth E Marks H Garrison Massey and Brent D Bradley Oct 1978 128 p
(Contract F49620-77-C-0023)
(AD-A064333 RAND/R-2287-AF) Avail NTIS HC A07/MF A01 CSCL 14/1

Although life cycle analysis is widely used as a management tool considerable uncertainty still exists about its effectiveness with respect to economic tradeoffs funding decisions and resource allocations This report evaluates some of the most widely used life cycle cost (LCC) models AFR 173-10 models (BACE AND CACE) the Logistics Support Cost Model the Logistics Composite model the MOD-METRIC model AFM 26-3 Manpower Standards Air Force Logistics Command Depot Maintenance Cost Equations the DAPCA model and the PRICE model The models are rated within a framework incorporating a set of life cycle cost elements and a set of cost driving factors Color-coded illustrations summarize the results The models are shown to have many shortcomings that limit their usefulness for life cycle analyses in which estimates of absolute incremental cost are required Specific areas are identified where driving factor/cost element combinations are not adequately addressed
Author (GRA)

N79-22996# Von Karman Inst for Fluid Dynamics, Rhode-Saint-Genese (Belgium)
STOL TECHNOLOGY, VOLUME 1
Sep 1973 198 p refs Lecture held at Rhode-Saint-Genese, Belgium 10-14 Sep 1973 2 Vol
(VKI-Lecture-Series-60-Vol-1) Avail NTIS HC A09/MF A01

Airworthiness and certification of civil aircraft wind tunnel corrections for STOL models large low speed wind tunnel requirements transport aircraft and takeoff and landing ground rules are discussed

N79-22997# Civil Aviation Authority London (England)
AIRWORTHINESS AND CERTIFICATION ASPECTS OF CIVIL AIRCRAFT FOR STOL
W R B Bryder and J A Carrodus *In* Von Karman Inst for Fluid Dyn STOL Technol Vol 1 Sep 1973 22 p

Avail NTIS HC A09/MF A01

A brief account of the work in hand is presented The C A A provisional airworthiness flight requirements for powered-lift aircraft are discussed Those areas where further work most needs to be done if the first certifications of STOL transport aircraft are to provide adequate safety levels without imposing undue economic penalty are indicated S E S

N79-22998# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
WIND TUNNEL CORRECTIONS FOR STOL MODELS
M Carbonaro *In its* STOL Technol Vol 1 Sep 1973 45 p refs
Avail NTIS HC A09/MF A01

A number of operational problems associated with the wind tunnel testing of V/STOL aircraft including helicopters are reviewed Wall corrections use of ventilated wall testing for ground effect, and flow distributions in the tunnel circuit are discussed S E S

N79-22999# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
REVIEW OF LARGE LOW SPEED WIND TUNNEL REQUIREMENTS FOR STOL TESTING
P E Colin *In its* STOL Technol Vol 1 Sep 1973 11 p refs
Avail NTIS HC A09/MF A01

The low speed end of the flight range in aerodynamic testing facilities was investigated in order to maintain a fully competitive industry The types of aircraft to be considered for low speed testing problem areas and facility requirements and proposals for low speed wind tunnels in the USA and in Europe S E S

N79-23000# Mississippi State Univ Mississippi State Raspet Flight Research Lab
REVIEW LECTURE ON TRANSPORT AIRCRAFT CONCEPTS, UTILIZATION AND PROSPECTS
Ernest J Cross Jr and Daniel Fraga (AFFDL) *In* Von Karman Inst for Fluid Dyn STOL Technol Vol 1 Sep 1973 61 p refs
Avail NTIS HC A09/MF A01

Performance requirements for short takeoff and landing capabilities impose special design problems that are particularly difficult to resolve for large transport aircraft are presented The fundamental relationships involved in the takeoff and landing distance of high speed aircraft were reviewed The lift coefficient and lift drag ratio subject to aerodynamic improvement are discussed The lift systems discussed include (1) high performance mechanical lift devices (2) boundary layer control high lift devices (3) deflected slipstream (4) internally blown jet flap (5) augmenter wing (6) externally blown jet flap (7) direct lift S E S

N79-23001# Mississippi State Univ Mississippi State
TAKEOFF AND LANDING GROUND RULES
Ernest J Cross, Jr *In* Von Karman Inst for Fluid Dyn STOL Technol, Vol 1 Sep 1973 22 p refs

Avail NTIS HC A09/MF A01

Ground rules applicable to powered lift aircraft are presented and reviewed A list of rules for defining military STOL performance was developed The components of the proposed rules are discussed so that the reader may gain information useful for aircraft design S E S

N79-23002# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
STOL TECHNOLOGY, VOLUME 2
Sep 1973 344 p refs Lecture held at Rhode-Saint-Genese, Belgium 10-14 Sep 1973 2 Vol
(VKI-Lecture-Series-60-Vol-2) Avail NTIS HC A15/MF A01

Volume 2 of a two volume lecture series is presented The following topics are discussed (1) airworthiness and certification aspects of civil aircraft for STOL, (2) wind tunnel corrections for STOL models, (3) review of large low speed wind tunnel requirements for STOL testing (4) takeoff and landing ground rules (5) flight dynamic problems with STOL operations (6) aerodynamics and performance characteristics of direct lift schemes (7) engine integration and noise considerations for STOL aircraft, and (8) special ground testing facilities and testing techniques for STOL aircraft

N79-23003# Hawker Siddeley Aviation Ltd Hatfield (England)
FLIGHT DYNAMICS PROBLEMS WITH STOL OPERATION

Michael Fay *In* Von Karman Inst for Fluid Dyn STOL Technol Vol 2 Sep 1973 33p refs

Avail NTIS HC A15/MF A01

The stability and control characteristics of large transport aircraft specifically designed to operate from runways of 1 500 ft and 2 000 ft are considered G Y

N79-23004# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

THE AERODYNAMICS AND PERFORMANCE CHARACTERISTICS OF DIRECT LIFT SCHEMES
H Friedel *In its* STOL Technol Vol 2 Sep 1973 30 p refs

Avail NTIS HC A15/MF A01

In the first part the fundamental relations for calculation of the performance characteristics are given with a detailed definition of the forces acting on direct lift schemes On the basis of some measurements given in the literature the jet-induced interference effects are explained The second part is concerned with the performance characteristics of direct lift schemes At first the influences of jet lift on the point-performance characteristics in horizontal flight climb and turn are shown In the following sections the short take-off and short landing characteristics are explained in some detail A short view on unsteady turn performance for aircrafts with thrust deflection is given also G Y

N79-23005# Rolls-Royce Ltd Derby (England)
ENGINE INTEGRATION AND NOISE CONSIDERATIONS FOR STOL AIRCRAFT
J A Hooper *In* Von Karman Inst for Fluid Dyn STOL Technol Vol 2 Sep 1973 50 p

Avail NTIS HC A15/MF A01

The achievement of short field performance together with good operational and economic characteristics impose demands upon the engine which can have a considerable influence on engine design Various forms of lift augmentation devices are considered and the associated engine/airframe integration problems are discussed The resulting effect on engine design is illustrated by considering some current engine proposals Noise is an extremely important consideration and the means and cost of achieving low noise levels are considered The considerable reduction in community noise levels that can be achieved is illustrated G Y

N79-23006# McDonnell-Douglas Corp Long Beach Calif V/STOL Systems Aerodynamic Technology
AERODYNAMICS AND PERFORMANCE CHARACTERISTICS OF WING LIFT AUGMENTATION SCHEMES
Michael L Lopez *In* Von Karman Inst for Fluid Dyn STOL Technol Vol 2 Sep 1973 75 p refs

Avail NTIS HC A15/MF A01

A discussion is presented which gives an introductory survey of aerodynamics and performance characteristics of wing lift augmentation schemes Attention is drawn to those methods of increasing lift that would be categorized as circulation control high lift concepts Emphasis is placed on those circulation control high lift concepts involving the application of the jet-flap principle Included among these concepts are the externally blown and internally ducted jet flap the augmentor wing or ejector jet flap and the over-the-wing or upper surface blown flap Other methods for increasing lift are briefly discussed so that the nonspecialist to this field might recognize the basic problems and the aerodynamic potential fo alternative schemes for STOL aircraft applications G Y

N79-23007# Office National d Etudes et de Recherches Aerospatiales Paris (France)
SPECIAL GROUND TESTING FACILITIES AND TESTING TECHNIQUES FOR STOL AIRCRAFT
Ph Poisson-Quinton and J Christophe *In* Von Karman Inst for Fluid Dyn STOL Technol Vol 2 Sep 1973 82 p

Avail NTIS HC A15/MF A01

Figures and illustrations are given for unusual characteristics of a STOL A/C basic testing on high lift devices in two-dimensional rigs major tunnels for V/STOL testing STOL testing techniques engine simulation on STOL models simulation of the ground effect on STOL models development of a special V/STOL rig inside the ONERA-S1 mondane tunnel gust simulation by jet control in wind tunnels free flight techniques and ground simulators G Y

N79-23008*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
COMPUTER FORMULATIONS OF AIRCRAFT MODELS FOR SIMULATION STUDIES
James C Howard May 1979 73 p refs
(NASA-TP-1470 A-7477) Avail NTIS HC A04/MF A01 CSCL 02A

Recent developments in formula manipulation compilers and the design of several symbol manipulation languages enable computers to be used for symbolic mathematical computation A computer system and language that can be used to perform symbolic manipulations in an interactive mode are used to formulate a mathematical model of an aeronautical system The example demonstrates that once the procedure is established the formulation and modification of models for simulation studies can be reduced to a series of routine computer operations J M S

N79-23012*# National Aeronautics and Space Administration Langley Research Center Hampton Va
FLIGHT INVESTIGATION OF PILOTING TECHNIQUES AND CROSSWIND LIMITATIONS USING A RESEARCH TYPE CROSSWIND LANDING GEAR
Bruce D Fisher Perry L Deal Robert A Champine and James M Patton Jr May 1979 55 p refs
(NASA-TP-1423 L-12682) Avail NTIS HC A04/MF A01 CSCL 01A

A research-type crosswind landing gear was tested in a flight program which used a light STOL transport in strong crosswind conditions The research-type crosswind landing gear used enabled the airplane to land to crosswinds up to a magnitude of 25 to 30 knots Three modes of landing-gear operation were investigated preset automatic and castor (passive self-alignment) Actual test data and histograms are given for the 195 visual flight rules crosswind landings made J M S

N79-23013*# National Aeronautics and Space Administration Langley Research Center Hampton Va
AERODYNAMIC CHARACTERISTICS AT MACH NUMBERS OF 1.5, 1.8, AND 2.0 OF A BLENDED WING-BODY CONFIGURATION WITH AND WITHOUT INTEGRAL CANARDS
A Warner Robins Milton Lamb and David S Miller May 1979 56 p refs
(NASA-TP-1427 L-12727) Avail NTIS HC A04/MF A01 CSCL 01A

An exploratory experimental and theoretical investigation was made of a cambered twisted and blended wing-body concept with and without integral canard surfaces Theoretical calculations of the static longitudinal and lateral aerodynamic characteristics of the wing-body configurations were compared with the characteristics obtained from tests of a model in the Langley Unitary Plan wind tunnel Mach numbers of 1.5 1.8 and 2.0 and a Reynolds number per meter of 6.56 million were used in the calculations and tests Overall results suggest that planform selection is extremely important and that the supplemental application of new calculation techniques should provide a process for the design of supersonic wings in which spanwise distribution of upwash and leading-edge thrust might be rationally controlled and exploited Author

N79-23016*# Boeing Commercial Airplane Co Seattle Wash
COMPUTER PROGRAM TO CALCULATE THREE-DIMENSIONAL BOUNDARY LAYER FLOWS OVER WINGS WITH WALL MASS TRANSFER Final Report
J D McLean and J L Randall May 1979 96 p refs
(Contract NAS1-15022)
(NASA-CR-3123 D6-46976) Avail NTIS HC A05/MF A01 CSCL 01A

A system of computer programs for calculationg three dimensional transonic flow over wings, including details of the three dimensional viscous boundary layer flow was developed The flow is calculated in two overlapping regions an outer potential flow region and a boundary layer region in which the first order three dimensional boundary layer equations are

numerically solved A consistent matching of the two solutions is achieved iteratively thus taking into account viscous-inviscid interaction For the inviscid outer flow calculations the Jameson-Caughey transonic wing program FLO 27 is used and the boundary layer calculations are performed by a finite difference boundary layer prediction program Interface programs provide communication between the two basic flow analysis programs Computed results are presented for the NASA F8 research wing both with and without distributed surface suction J M S

N79-23017# ARO Inc Arnold Air Force Station Tenn
COMPARISON OF STORE TRAJECTORY AND AERODYNAMIC LOADS, AND MODEL FLOW-FIELD CHARACTERISTICS OBTAINED IN THE AEDC PWT/4T AND VFK/A WIND TUNNELS AT MACH NUMBER 1 63 Final Report
D W Hill Jr J T Best and R H Tolbert AEDC Feb 1979 77 p refs
(AD-A065137 AEDC-TR-78-45) Avail NTIS HC A05/MF A01 CSCL 14/2

Tests were conducted in the VKF/A and PWT/4T wind tunnels at AEDC to obtain captive trajectory aerodynamic loads and flowfield data in order to assess the ability to reproduce trajectories from tunnel to tunnel The data were obtained with a 0 05-scale generalized shape aircraft model an ogive-cylinder store model, and conical flow survey probes at and near the centerline fuselage station pylon and the wing 1/3-semispan station pylon The tests were conducted at a Mach number of 1 63 with aircraft model angle of attack set at zero Generally the trajectories obtained in the two wind tunnels compared well There was very good agreement in the translational motion of the store trajectories with only slight differences in the angular motion in selected cases Author (GRA)

N79-23020# Lockheed-Georgia Co , Marietta
DEVELOPMENT OF A VISCOUS VORTEX/WING INTERACTION PROGRAM FOR THICK WINGS WITH BOUNDED LEADING EDGE Final Report
Charles J Dixon and S Sampath 30 Nov 1978 93 p refs
(Contracts N00014-74-C-0151 RR0141184)
(AD-A065181, LG78ER0227 ONR-CR215-233-4F) Avail NTIS HC A05/MF A01 CSCL 20/4

A hybrid viscous/potential flow program was developed to analyze the flow field on and around a swept thick wing with rounded leading edges and leading edge vortex flow The program provides a computational package which includes four major programs run with proper interfacing in an iterative cycle These programs include two viscous programs and two potential flow programs The viscous flow programs consist of (1) a parabolic solution to the Navier-Stokes vorticity equation in a box around the leading edge vortex and (2) a three-dimensional second-order boundary layer program for infinite yawed wings This program provides the boundary layer vorticity being fed into the vortex box The two potential flow programs are (1) the Hess surface singularity method for thick wings and fuselage combination and (2) a vortex lattice method to model the leading edge vortex These two programs provide the surface pressures and the viscous box boundary velocities The program interfaces are developed by applying the concept to a 65 deg delta wing with a spanwise variation in leading edge radius Operating experience is presented giving the results and knowledge gained in each cycle of the iterations The method allows the designer to design or modify the leading edge shape to meet the desired performance and control requirements GRA

N79-23028# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio Aerodynamics and Airframe Branch
A NUMERICAL SOLUTION OF SUPERSONIC AND HYPERSONIC VISCOUS FLOW FIELDS AROUND THIN PLANAR DELTA WINGS Final Report
Guion S Bluford Jr Sep 1978 235 p refs
(AF Proj 2307)
(AD-A065632 AFFDL-TR-78-98) Avail NTIS HC A11/MF A01 CSCL 01/3

A numerical technique was used to compute the supersonic and hypersonic viscous flow fields around thin planar delta wings These solutions were obtained by solving the Navier-Stokes equations subject to a conical approximation The integration technique used was the MacCormack finite-difference scheme Solutions were obtained for the upper-only lower-only and total flow fields around delta wings with supersonic leading edges GRA

N79-23046# Bristol Univ (England) Dept of Aeronautical Engineering
AN INVESTIGATION INTO THE TRANSIENT AERODYNAMICS ASSOCIATED WITH A SPOILER EMERGING INTO A UNIFORM AIRSTREAM B S Thesis
A Bannister and P B Tuffley Jun 1978 91 p refs
(BU-219) Avail NTIS HC A05/MF A01

Tests were conducted to determine how the flow around a spoiler emerging into a uniform airstream develops A water table model was used to provide a hydraulic analogy Photographs show the results obtained Tests were conducted in a low speed wind tunnel to determine pressure variation along the extended center line of a model spoiler Plots show how the extent to which the spoiler has emerged is related to the extent of the separated region downstream Author (ESA)

N79-23047# Bristol Univ (England) Dept of Aeronautical Engineering
AN INVESTIGATION INTO THE PRESSURE DISTRIBUTIONS OVER A WING AND STORE COMBINATION AT LOW SPEEDS B S Thesis
S P Newbold and J E Zacharakis Jun 1978 149 p refs
(BU-226) Avail NTIS HC A07/MF A01

A wind tunnel investigation was carried out in regard to pressure distributions over the surfaces of a wing section and store combination at an angle of incidence of 8 deg to a uniform airflow at a Reynolds number based on store diameter, of 1 6 x 100 000 Pressure distributions are presented for a range of separation distances between the wing and store Results show that the presence of the wing section produced a large effect on the distribution over the store but the effect of the store on the airfoil pressure distribution was negligible The results indicated a reduction in the effective store incidence when in close vicinity of the wing The vortex pair formed on the store vanished when the separation distance of the two bodies was reduced below one store diameter The effect of Reynolds number on the pressure distribution was also investigated Author (ESA)

N79-23048# Bristol Univ (England) Dept of Aeronautical Engineering
THE EFFECT OF SURFACE IMPERFECTIONS ON THE AERODYNAMIC PERFORMANCE OF AN AIRFOIL AT MODERATE REYNOLDS NUMBERS B S Thesis
T R Byram and N J Came Jun 1978 68 p refs
(BU-217) Avail NTIS HC A04/MF A01

The aerodynamic performance of a two-dimensional NACA 0015 airfoil was investigated over a range of Reynolds numbers from 1 5 to 4 5 x 100 000 The results correspond to higher free air Reynolds numbers than these due to wind tunnel turbulence of the order of 1 percent Variations of lift, drag pitching moment, and control hinge moment were investigated for various imperfections These imperfections covered variations in both leading edge and control surface profile For all cases tested including the standard airfoil there was a dependence of the results on the Reynolds number In general the introduction of imperfections produced a poorer performance compared to the standard airfoil section Author (ESA)

N79-23051# Royal Aircraft Establishment Farnborough (England) Aerodynamics Dept
A BRIEF REVIEW OF AIR FLIGHT WEAPONS
George G Brebner *In* AGARD Missile Aerodynamics Feb 1979 12 p
Avail NTIS HC A17/MF A01

The differences in design objectives and consequently in geometry between aircraft and weapons, and the aerodynamic repercussions are described Various general categories of air flight weapons are listed propelled and unpropelled guided and

unguided and in the particular category of propelled guided weapons different classes are identified The following components of a guided weapon are described briefly warhead propulsive unit safety and arming mechanism fuze guidance system and control system Their functions and their effects on the aerodynamic design are described The place of the aerodynamicist in the design of a guided weapon is discussed and related to the various stages of the design and development process G Y

N79-23053# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Inst fuer Theoretische Stroemungsmechanik

AERODYNAMICS OF LOW ASPECT RATIO WINGS

W H Stahl *In* AGARD Missile Aerodynamics Feb 1979 64 p refs

Avail NTIS HC A17/MF A01

The types of wings are discussed which generally find application on missiles that is with wings having delta rectangular trapezoidal or other planform of more or less small aspect ratio An overview over the available experimental evidence for the flow fields of such wings is given, as well as a discussion of measured pressure distributions forces and moments at low and high speeds also the influence of Reynolds number is considered Various methods to predict the aerodynamic characteristics of such wings are reviewed and comparisons are made between theoretical and experimental results An extensive list of references is provided G Y

N79-23060# Federal Aviation Administration Washington D C

NATIONAL AIRPORT SYSTEM PLAN 1978 - 1987

[1978] 446 p Original contains color illustrations

Avail NTIS MF A01, SOD HC

The need for civil airports in the decade ahead is presented A system of public airports the formulation coordination and implementation of the National airport system plan the airport and its system role system development requirements National requirements and state requirements and individual airport data are discussed S E S

N79-23061# Analysis and Technology Inc North Stonington Conn

ANALYSIS OF VISUAL DETECTION PERFORMANCE FALL 1978 EXPERIMENT Interim Report, Jan - Dec 1978

N C Edwards Jr (Coast Guard Groton, Conn) T J Mazour D R Bouthilette and S R Osmer (Coast Guard Groton Conn) Dec 1978 131 p refs

(Contract N00014-78-C-0810)

(AD-A065118 USCG-D-03-79) Avail NTIS HC A07/MF A01 CSCL 06/7

From 11 September 1978 to 6 October 1978 a visual detection experiment was conducted in Block Island sound by the U S Coast Guard Research and Development Center It was the first in a series of experiments designed to improve search planning guidance contained in the National Search and Rescue Manual This was a controlled experiment involving 82 and 95 foot cutters 41 and 44 foot boats helicopters and fixed wing aircraft searching for white 16 foot boat targets anchored at predetermined locations within the search area Through the use of a microwave ranging system the positions of searchers and targets could be accurately reconstructed to determine the lateral range of targets that were detected as well as targets not detected Thus probability of detection versus lateral range curves could be developed and, by integrating these curves, sweep width could be determined as well A total of 695 detection opportunities were generated A sophisticated binary multivariate logistic regression computer program was used to develop sweep width estimates for the environmental conditions experienced Of the eight visual detection parameters investigated visibility wind speed swell height cloud cover search unit type and duration of search were determined to have a significant effect on sweep width The sweep width is an excellent measure of search unit performance A more rapid degradation of sweep width was found for deteriorating environmental conditions than is now predicted by the National Search and Rescue Manual The methods used to conduct this experiment and analyze the data were found to be successful and are recommended for future experiments GRA

N79-23062# Air Force Geophysics Lab Hanscom AFB Mass

FORWARD SCATTER METER MEASUREMENTS OF SLANT VISUAL RANGE

Wayne S Hering and Edward B Geisler 9 Aug 1978 29 p refs

(AD-A064429 AFGL-TR-78-0191 AFGL-AFSG-393) Avail NTIS HC A03/MF A01 CSCL 20/6

The potential for remote tower measurements of point visibility in the determination of slant range visibility for aircraft landing operations was explored through analysis of data collected at the Air Force Geophysics Laboratory Weather Test Facility at Otis AFB Massachusetts This report described initial experiments that deal with an analysis of the small scale variability of extinction coefficient in time and space Data from two instrumented towers spaced 1500 ft apart were classified for investigation of the horizontal variability of visibility at elevations up to 100 ft and space-time variability for lag periods from 0 to 10 minutes The preliminary tests give additional evidence that the runway visual range (RVR) measurements alone often are not representative of pilot visibility during approach and touchdown Remote measurements of visibility using either a 50-ft or 100-ft instrumented tower would add significantly to the real safety of sea-to-land operations under conditions of Categories I, II and IIIa through an improved description of conditions related to airfield visibility Author (GRA)

N79-23063# Naval Ocean Systems Center San Diego Calif

OMEGA POSSIBILITIES LIMITATIONS, OPTIONS, AND OPPORTUNITIES Final Report, Jan - Jul 1978

E R Swanson J E Britt and A N Smith Jun 1978 86 p (AD-A065027 NOSC/TR-283) Avail NTIS HC A05/MF A01 CSCL 17/7

Omega is reviewed from the vantage point of several years operational experience with the system in nearly final configuration After identification of some possible shortcomings or deficiencies system design parameters are re-examined with a view to determining possible investigations modifications or changes which might mitigate or lead to elimination of difficulties The primary form of review is a re-examination of design in hindsight using modern theory and considering modern engineering options to determine weaknesses and areas susceptible to improvement Potential coverage limitations were identified in several areas while a coverage deficiency in central North America is to be expected Significant reception difficulties have been noted in aircraft Specific recommendations are made for investigations leading to improved receiver design and to mitigate reception problems in aircraft Despite system maturity a considerable and perhaps surprising latitude exists for modifications Methods are presented by which one or more additional stations can be added without obsoleting existing equipment Author (GRA)

N79-23064*# Textron Bell Helicopter Fort Worth Tex

CORRELATION STUDY BETWEEN VIBRATIONAL ENVIRONMENTAL AND FAILURE RATES OF CIVIL HELICOPTER COMPONENTS

Orlando Alaniz May 1979 75 p refs

(Contract NAS1-15078)

(NASA-CR-159033) Avail NTIS HC A04/MF A01 CSCL 01C

An investigation of two selected helicopter types namely the Models 206A/B and 212 is reported An analysis of the available vibration and reliability data for these two helicopter types resulted in the selection of ten components located in five different areas of the helicopter and consisting primarily of instruments electrical components and other noncritical flight hardware The potential for advanced technology in suppressing vibration in helicopters was assessed The are still several unknowns concerning both the vibration environment and the reliability of helicopter noncritical flight components Vibration data for the selected components were either insufficient or inappropriate The maintenance data examined for the selected components were inappropriate due to variations in failure mode identification inconsistent reporting or inaccurate informaton M M M

N79-23065# Douglas Aircraft Co Inc Long Beach Calif
ACTIVE CONTROL TRANSPORT DESIGN CRITERIA
Robert W Harris and William W Rickard 9 Nov 1978 15 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft Sep 1979
(Paper-6663) Avail NTIS HC A02/MF A01

The definition and background of active control technology are presented and the functions contemplated to be performed by active control systems are discussed The various design criteria for each is discussed and the subject of government regulations affecting aircraft design is reported M M M

N79-23066# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
AEROSPACE TRANSPARENT MATERIALS AND ENCLOSURES (12TH)
Robert E Wittman Dec 1978 876 p refs Conf held at Long Beach Calif 24-28 Apr 1978
(AD-A065049 AFFDL-TR-78-168) Avail NTIS HC A99/MF A01 CSCL 01/3

The purpose of this report is to make available the technical papers presented at the Twelfth Conference on Aerospace Transparent Materials and Enclosures Thirty-eight technical papers are presented in seven sessions that address transparency design and performance characterization materials and processes and bird impact resistance The papers contained herein have been reproduced directly from the original manuscripts
Author (GRA)

N79-23067# United Technologies Corp Stratford Conn Sikorsky Aircraft Div
HELICOPTER TRANSPARENT ENCLOSURES VOLUME 2 A GENERAL SPECIFICATION Final Report
Bruce F Kay Jan 1979 63 p refs
(Contract DAAJ02-74-C-0065)
(AD-A065462 SES-501011 USARTL-TR-78-25B) Avail NTIS HC A04/MF A01 CSCL 01/3

General specification design development and acceptance criteria are presented Guidelines for performing tradeoffs between conflicting criteria are given S E S

N79-23068# Sikorsky Aircraft Stratford Conn Sikorsky Aircraft Div
HELICOPTER TRANSPARENT ENCLOSURES VOLUME 1 DESIGN HANDBOOK Final Report
Bruce F Kay Jan 1979 461 p refs
(Contract DAAJ02-74-C-0065)
(AD-A065268 SER-50966-Vol-1 USARTL-TR-78-25A-Vol-1) Avail NTIS HC A20/MF A01 CSCL 01/3

The Volume I design handbook is a comprehensive guide to the development of helicopter transparent enclosures The handbook is structured in a manner that generally parallels the sequence of considerations used to develop helicopter transparencies Separate chapters are devoted to subjects pertinent to the design analysis and testing of transparent enclosures Special characteristics and material properties are presented as applicable GRA

N79-23069# Hughes Helicopters Culver City Calif
EVALUATION OF AN ENERGY DISTRIBUTION SYSTEM FOR HELICOPTER LANDING GEARS DURING HARD LANDING Final Report, 1 Mar 1977 - Sep 1978
A H Logan C A Waldon and F Fourt Nov 1978 120 p refs
(Contract DAAJ02-77-C-0019)
(AD-A065298 HH-78-149 USARTL-TR-44) Avail NTIS HC A06/MF A01 CSCL 01/3

An experimental program was conducted to evaluate a landing gear concept that redistributes the impact energy of an autorotational landing This landing gear concept redistributes the impact energy by providing an interconnection between the front and rear landing gears Through the interconnection as the rear landing gear moves from the flight position toward the full compressed position under landing impact the front gear is impelled to move from the flight position toward the fully extended position When these motions have been accomplished the skids remain on the ground surface throughout the landing greatly reducing the pitching moments The landing gear was drop tested to demonstrate the effects of sink rate gross weight center-of-gravity (CG) location touchdown attitude (both pitch and yaw) ground resonance system damping and spring rate The testing included drop velocities up to 19 5 feet per second and simulated forward and lateral speed landings For purpose of design and development the OH-6A helicopter was used as the baseline aircraft and the landing gear was designed to require minimum modification to the OH-6A The results of the testing showed that the interconnected landing gear reduces the nosedown pitching velocities and angles during autororation landings A cost analysis indicated that incorporation of the interconnected landing gear in new production aircraft would result in a return on investment greater than 2 1 GRA

N79-23070# Aerospace Medical Research Labs Wright-Patterson AFB Ohio
INFLUENCE OF GRIDBOARD LINE WIDTH AND SPACING ON WINDSCREEN DISTORTION MEASUREMENTS
Rickey C Seid and Herschel C Self Dec 1978 31 p
(AD-A065821 AMRL-TR-78-93) Avail NTIS HC A03/MF A01 CSCL 12/1

Optical distortions of aircraft windscreens are commonly measured on photographs taken through the windscreens of a large flat Cartesian grid called a gridboard Presently there are no accepted standards for the width of the lines or the size of the squares on gridboards This study measured the effects of these variables upon measurements of vertical and horizontal magnifications to aid in establishing standards GRA

N79-23071# Illinois Inst of Tech Chicago Dept of Mechanics and Mechanical and Aerospace Engineering
STUDIES OF THE DYNAMIC STALL OR AIRFOIL PROFILES FOR HELICOPTER ROTORS Final Report, 1 Jun 1975 - 30 Sep 1978
Andrew A Fejer 20 Jan 1979 15 p refs
(Grant DAHC04-75-G-0142)
(AD-A065106) Avail NTIS HC A02/MF A01 CSCL 20/4

The interaction of oscillations of the mean velocity of the relative flow with the periodic changes in angle of attack that are produced in the forward flight of helicopters on the airfoil profiles of the rotors has been investigated for the first time The study conducted in the IIT 2 ft x 2 ft oscillating flow wind tunnel coupled with visual observations in a small water tunnel has revealed that the aerodynamic characteristics of oscillating flows in steady flow documented by a number of investigators may be altered significantly when oscillations of the flow velocity are superimposed on those of the angle of attack of the airfoil Author (GRA)

N79-23072# Bristol Univ (England) Dept of Aeronautical Engineering
A STUDY OF THE SHERIFF'S WING B S Thesis
R B Eckersley and N J Sibley Jun 1978 86 p refs
(BU-215) Avail NTIS HC A05/MF A01

A design study of the Sheriff aircraft s wing was undertaken to assess the proposed design and to investigate and suggest improvements The Sheriff s slotted flap was examined and the utility of optimizing a hinge position with respect to take-off and landing was found to be small The roll performance was predicted to be poor compared with other general aviation aircraft Simplicity of construction was also considered with respect to flaps Although the study is specific to the Sheriff there are useful implications for light aviation to be considered
Author (ESA)

N79-23073# Bristol Univ (England) Dept of Aeronautical Engineering
THE ELECTRO-IMPULSE DE-ICING METHOD B S Thesis
V G Mitriou and S G Jancovich Jun 1978 100 p refs
(BU-227) Avail NTIS HC A05/MF A01

The mechanism of crack formation and the failure of ice due to the sudden displacement of the metal to which it is attached were investigated Various tests were made to check the efficiency versatility, and possibility of future application of electroimpulse deicing system A horizontal contilever beam

was set up, part of which was covered by ice or a specific mixture of mortar whose properties simulated those of ice Impacts were applied at various distances from the end of the beam and the pattern in which the ice or mortar layer failed was obwerved Parameters such as beam length distance from impact, layer thickness and temperature of ice were taken into consideration A simple theory for static loadings of the beam was also developed through which some numerical values for the various stiffnesses and strengths of the mortar were obtained The extent to which this simple static case theory could realistically represent the dynamic situation was discussed For all tests standard aircraft aluminum alloy was used Author (ESA)

N79-23074# Advisory Group for Aerospace Research and Development Paris (France)
HELICOPTER FATIGUE A REVIEW OF CURRENT REQUIREMENTS AND SUBSTANTIATION PROCEDURES
Feb 1979 74 p refs In ENGLISH partly in FRENCH Presented at the 47th Meeting of the Struct and Mater Panel, Florence 25-29 Sep 1978
(AGARD-R-674 ISBN-92-835-0232-9) Avail NTIS HC A04/MF A01

A detailed review of current fatigue requirements and substantiation procedures in the United States United Kingdom Germany, Italy, and France in the field of helicopter fatigue is presented Although general requirements and specifications seem to be very similar approved procedures applied by manufacturers may sometimes appear to be rather arbitrary or in some cases to differ significantly from one firm to another

N79-23075# Army Aviation Research and Development Command St Louis Mo Structures and Aeromechanics Branch
US ARMY HELICOPTER FATIGUE REQUIREMENTS AND SUBSTANTIATION PROCEDURES
Robert A Wolfe and Robert W Arden *In* AGARD Helicopter Fatigue Feb 1979 p 1-12 refs

Avail NTIS HC A04/MF A01

The current fatigue criteria and testing requirements are provided for U S Army helicopter structures with primary emphasis on dynamic components The comparative industry applications of the requirements were brought to light as a result of the Army s latest major helicopter competitions for the Utility Tactical Transport Aircraft System recently designated BLACK HAWK and the Advanced Attack Helicopter These competitions resulted in evaluations by the Army of four major helicopter companies (two competitors for each program) and provided significant lessons learned in future Army fatigue requirements primarily because of differences in loads application S/N curves shape criteria working level curve deviations and component testing techniques applied by each contractor These differences and how they relate to the current Army requirements were addressed As a result of these lessons learned the Army is in the process of specifying new fatigue requirements for future helicopter procurements J A M

N79-23076# Westland Helicopters Ltd Yeovil (England)
HELICOPTER FATIGUE EVALUATION THE UK APPROACH
A D Hall *In* AGARD Helicopter Fatigue Feb 1979 p 13-20

Avail NTIS HC A04/MF A01

The philosophies of fatigue substantiation were used satisfactorily for the Lynx and it is considered that the practicability of the approach has been well established The main concern was with the safe fatigue life substantiation of the vital components of a helicopter and consideration is given to three phases in the life cycle i e design, development and production It is shown how the prototype aircraft is defined from the fatigue strength point of view and how flight testing and development testing of the prototype leads in turn to the production definition J A M

N79-23077# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
FATIGUE LIFE ESTIMATION METHODS FOR HELICOPTER STRUCTURAL PARTS
F Och *In* AGARD Helicopter Fatigue Feb 1979 p 21-27 refs
Avail NTIS HC A04/MF A01

Analytical fatigue life estimation mainly consisted of three steps prediction of loads, determination of fatigue strength, and application of a damage hypothesis linking these two aspects Following the above mentioned three steps of fatigue life investigation methods for the prediction of loads were dealt with according to the available amount of information Similarly it then investigated methods describing the fatigue strength of components taking into account the influence of steady loads and the reduction of a mean S/N curve to a working level curve J A M

N79-23078# Costruzioni Aeronautiche Giovanni Agusta S p A Gallarate (Italy)
PRESENT FATIGUE ANALYSIS AND DESIGN OF HELICOPTERS REQUIREMENTS AND QUALIFICATION PROCEDURES
Pietro Alli *In* AGARD Helicopter Fatigue Feb 1979 p 29-46 refs
Avail NTIS HC A04/MF A01

The state-of-the-art in AGUSTA in the area of structural fatigue and fail-safe strength evaluation is reported The need of general regulations and procedures was pointed out The convenience of automatic procedures was underlined J A M

N79-23079# Societe Nationale Industrielle Aerospatiale Paris (France) Helicopter Div
FATIGUE OF HELICOPTERS SERVICE LIFE EVALUATION METHOD
F Liard *In* AGARD Helicopter Fatigue Feb 1979 p 47-69 In ENGLISH and FRENCH

Avail NTIS HC A04/MF A01

The general principle of fatigue substantiation for helicopter components consists in evaluating the fatigue strength of the component determining the value and frequency of the loads to which it will be subjected during normal operation, and then deriving from these data the steps to be taken to make the possible occurrence of serious accidents due to the failure of the component extremely remote The method differs for the parts mainly di uensioned by high cycle fatigue (rotors and gearboxes) and for those subjected to low cycle fatigue (e g fuselage) Safety is determined from the stress in the 1st case and the number of cycles in the 2d case Where both types of fatigue are encountered various methods allow taking into account their superimposition but each of them leads to practical problems These two modes of fatigue being two aspects of a same phenomenon it seems realistic to use a single approach and select the acceptable total risk, whether the damage is calculated for each load level or the tests are conducted under programmed loads In both cases it would be necessary to have the equal probability-of-failure curves between a few cycles and the infinite which has not been achieved to date Composite materials could be given the same treatment as metals as reqards fatigue strength and that their fail safety could be taken into account when the first deteriorate appear on external surfaces A R H

N79-23080*# National Aeronautics and Space Administration Langley Research Center Hampton Va
COMPARISON OF ELECTROMECHANICAL AND CATHODE-RAY-TUBE DISPLAY MEDIUMS FOR AN INSTRUMENT APPROACH DISPLAY
Terence S Abbott May 1979 16 p refs
(NASA-TM-80069, L-12805) Avail NTIS HC A02/MF A01 CSCL 01D

The effect on pilot performance of replacing a single electromechanical display with similar cathode-ray-tube displays was studied The effects of dimensionality, color and shading were evaluated with respect to the pilot s ability to interpret and respond to displayed information S E S

N79-23081*# National Aeronautics and Space Administration Langley Research Center Hampton, Va
MINIATURE FLOW-DIRECTION AND AIRSPEED SENSOR FOR AIRPLANES AND RADIO CONTROLLED MODELS IN SPIN STUDIES
David D Kershner May 1979 27 p refs
(NASA-TP-1467, L-12812) Avail NTIS HC A03/MF A01 CSCL 01D

A miniature flow direction and airspeed sensor was developed for use on 1/10- to 1/15 scale models and on full-scale airplanes engaged in spin research The range of flow angles encountered in spinning flight (+ or - 120 degrees in angle of attack and + or - 55 degrees in sideslip) is larger than that of normal flight These angles along with an effective airspeed range of 9 to 90 m/sec were measured with static accuracies of + or - 0 35 degrees for angle of attack + or - 0 25 degrees for sideslip angle, and + or - 1 m/sec for airspeed The dynamic accuracy is adequate to measure the rapidly changing flow angles and airspeed without singificant distortion The sensor is rugged enough to withstand both the airplane environment and that of the radio-controlled unpowered models Author

N79-23082# Draper (Charles Stark) Lab , Inc Cambridge, Mass
AN INTEGRATED FAULT-TOLERANT AVIONICS SYSTEM CONCEPT FOR ADVANCED AIRCRAFT Final Report
1 Feb 1979 326 p refs
(Contract N00019-78-C-0572)
(AD-A065136, R-1226) Avail NTIS HC A15/MF A01 CSCL 01/3

A conceptual baseline design for a highly integrated fault- and damage-tolerant avionics architecture is presented The architecture is generic in nature, and applicable to a broad range of aircraft types, including CTOL, VTOL and V/STOL and all classes from supersonic fighters to transports The architecture embodies pools of modular resources configured to flexibly serve required functions on a priority basis By including system elements which can serve multiple functions and taking maximum advantage of systematic fault-tolerance methods and procedures the design tends to minimize replication of elements and overall complexity In concert with logistics and maintenance procedures designed around the pooled modular element approach the architecture can provide required performance, reliability damage tolerance and availability at minimum life-cycle costs Its inherent flexibility allows it to readily incorporate a wide variety of mission-specific elements and to easily adapt to growth and change as new elements and requirements arise
Author (GRA)

N79-23083# TRW Defense and Space Systems Group Redondo Beach Calif
STANDARD AVIONICS MODULES (SAM) FOR EXISTING MODEMS Final Report, Jul 1976 - Dec 1977
Douglas Au and Stanley Ogi Wright-Patterson AFB Ohio AFAL Oct 1978 428 p
(Contract F33615-76-C-1307 AF Proj 7662)
(AD-A065629 AFAL-TR-78-47) Avail NTIS HC A19/MF A01 CSCL 09/5

The objective of this project was to demonstrate the feasibility and cost effectiveness of applying the Standard Avionic Modules concept to communication/navigation ECCM modems To make the project more tractable and more relevent two L-band com/nav systems and a general PN PSK modem were considered The two com/nav systems were JTIDS and GPS and the PN PSK modem was an AJ modem using PN spreading and was capable of a data rate of 38 4 KBPS A performance analysis resulted in a set of composite performance requirements Signal processing functions were defined which would satisfy the performance requirements With the performance requirements and signal processing functions several architectures were analyzed and partitioning of the modem function was undertaken The final configuration of the modem was directly dependent upon the physical packaging technique adapted The Navy SHP approach was compared to the Air Force ATR standard specifically the 1/2 ATR standard and was discarded because of several deficiencies GRA

N79-23084*# Pratt and Whitney Aircraft Group East Hartford Conn Commercial Products Div
VARIABLE CYCLE ENGINE TECHNOLOGY PROGRAM PLANNING AND DEFINITION STUDY Final Report
J S Westmoreland and A M Stern Sep 1978 89 p
(Contract NAS3-20811)
(NASA-CR-159539, PWA-5581-12) Avail NTIS HC A05/MF A01 CSCL 21E

The variable stream control engine VSCE-502B was selected as the base engine with the inverted flow engine concept selected as a backup Critical component technologies were identified, and technology programs were formulated Several engine configurations were defined on a preliminary basis to serve as demonstration vehicles for the various technologies The different configurations present compromises in cost technical risk and technology return Plans for possible variably cycle engine technology programs were formulated by synthesizing the technology requirements with the different demonstrator configurations J M S

N79-23085*# Pratt and Whitney Aircraft Group, East Hartford Conn
STUDY OF BLADE ASPECT RATIO ON A COMPRESSOR FRONT STAGE AERODYNAMIC AND MECHANICAL DESIGN REPORT
G D Burger D Lee and D W Snow Mar 1979 84 p refs
(Contract NAS3-20809)
(NASA-CR-159555 PWA-5583-25) Avail NTIS HC A05/MF A01 CSCL 21E

A single stage compressor was designed with the intent of demonstrating that for a tip speed and hub-tip ratio typical of an advanced core compressor front stage the use of low aspect ratio can permit high levels of blade loading to be achieved at an acceptable level of efficiency The design pressure ratio is 1 8 at an adiabatic efficiency of 88 5 percent Both rotor and stator have multiple-circular-arc airfoil sections Variable IGV and stator vanes permit low speed matching adjustments The design incorporates an inlet duct representative of an engine transition duct between fan and high pressure compressor S E S

N79-23086*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EFFECT OF PRIMARY-ZONE EQUIVALENCE RATIO ON POLLUTANT FORMATION
Russell W Claus May 1979 20 p refs
(NASA-TP-1463 E-9896) Avail NTIS HC A02/MF A01 CSCL 21E

Test were conducted to determine the effect of primary-zone equivalence ratio on the formation of smoke and other gaseous pollutants in an experimental can combustor Several fuel injection techniques were examined at primary-zone equivalence ratios from 0 8 to 2 0 The main emphasis was on reducing fuel-rich-combustion smoke levels Two of the four fuel injection configurations studied produced smoke levels below a smoke number of 20 at a primary-zone equivalence ratio of about 1 7 As the fuel mixing and atomization were recorded at primary-zone equivalence ratios as high as 2 0 The gaseous emissions of unburned hydrocarbons carbon monoxide and oxides of nitrogen were quite sensitive to the fuel injection configuration as well as to the primary-zone equilvalence ratio Author

N79-23087*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif
EFFECT OF NUMBER OF PROBES AND THEIR ORIENTATION ON THE CALCULATION OF SEVERAL COMPRESSOR FACE DISTORTION DESCRIPTORS
Frederick Stoll Jeffrey W Tremback and Henry H Arnaiz May 1979 42 p refs
(NASA-TM-72859, H-1070) Avail NTIS HC A03/MF A01 CSCL 21E

A study was performed to determine the effects of the number and position of total pressure probes on the calculation of five compressor face distortion descriptors This study used three sets of 320 steady state total pressure measurements that were obtained with a special rotating rake apparatus in wind

tunnel tests of a mixed-compression inlet The inlet was a one third scale model of the inlet on a YF-12 airplane and it was tested in the wind tunnel at representative flight conditions at Mach numbers above 2 0 The study shows that large errors resulted in the calculation of the distortion descriptors even with a number of probes that were considered adequate in the past There were errors as large as 30 and -50 percent in several distortion descriptors for a configuration consisting of eight rakes with five equal-area-weighted probes on each rake Author

N79-23088# Aeronautical Research Labs Melbourne (Australia)
DIGITAL DATA ACQUISITION SYSTEM FOR USE IN AIRCRAFT ENGINE CONDITION MONITORING
M T Adams Aug 1978 47 p refs
(ARL-Mech-Eng-Rept-151 AR-001-298) Avail NTIS HC A03/MF A01

A digital data acquisition system is described which was developed as part of a project to investigate assessment of aircraft engine condition from in-flight recording of a number of parameters The recording system is based on a small inexpensive audio tape recorder and accpts up to 12 analogue inputs and 4 digital inputs Recording of data in digital form is made on a standard cassette using a novel frequency coding technique Other novel aspects of the system are the successful application of a computer-like architecture to an essentially simple system and the ease with which data can be displayed for calibration and pre-flight checks with simple hand held test gear M M M

N79-23089# North Carolina State Univ at Raleigh Engineering Design Center
AN EXPERIMENTAL STUDY OF THE RESPONSE OF A TURBO-MACHINE ROTOR TO A LOW FREQUENCY INLET DISTORTION Interim Report, Jan 1976 - Dec 1978
Larry Hardi Dec 1978 164 p refs Prepared in cooperation with United Technol Res Center
(Contract F44620-76-C-0055 Grant AF-AFOSR-2802-75)
(AD-A064776 NCSU/EDC-78-6 AFOSR-79-0073TR) Avail NTIS HC A08/MF A01 CSCL 21/5

As part of a joint technical effort involving North Carolina State University and United Technologies Research Center an experiment was conducted to measure the response of an isolated turbomachine rotor to a distortion in inlet axial velocity A once-per-revolution sinusoidal variation in axial velocity with an amplitude of approximately twenty percent of the average axial velocity was generated by an upstream screen The response of the rotor was studied using pressure transducers and skin friction gages mounted on one of the rotor blades and a velocity probe at the rotor exit plane as well as with standard stationary frame pneumatic instrumentation The rotor was operated in undistorted flow to establish the quasi-steady behavior of the compression system When the air inlet angle was reduced past a certain limit the rotor began to experience rotating stall When the rotor was operated in distorted flow the pressures on the surface of the instrumented blade were observed to vary as a function of the instantaneous inlet angle These variations were greatest at the leading edge of the airfoil and became smaller toward the trailing edge This concentration of activity in the leading edge region is more pronounced than has been observed for isolated airfoils As the instrumented blade traversed the distortion, it was observed to operate transiently at inlet angles below the quasi-steady stall point in an apparently unstalled condition GRA

N79-23090# General Electric Co Cincinnati Ohio Aircraft Engine Group
ANALYTICAL DERIVATIVES Final Technical Report, Jun Sep 1978
D F Berg W C Colley and G L Converse Dec 1978 72 p
(Contract F33615-78-C-2203 AF Proj 3066)
(AD-A064944 R78AEG517 AFAPL-TR-78-101) Avail NTIS HC A04/MF A01 CSCL 21/5

The variable cycle engines now being studied for preliminary engine-aircraft design have greatly increased the complexity of engine modeling control element design and cycle calculation relative to the simpler turbofan and turbojet engines which preceeded them The production of engine data is the major computations cost element in mission studies and optimization investigations this problem can become even more severe in the future unless improvements in cycle calculations and component modeling techniques are developed and introduced now The current method of obtaining balanced cycle data points is to use the simultaneous Newton-Raphson iteration method The partial derivatives are obtained by numerical differentiation This report documents the results obtained by calculating the partial drivatives from analytical expressions obtained by differentiating a cycle deck Examples illustrating both the method of obtaining the analytical derivatives as well as setting up the control logic are given A cost comparison was carried out between two engine simulations using numerical derivatives and the same pair of engine simulations using analytical derivatives A data matrix consisting of the same 411 operating points was used for each of the engine simulation comparisons GRA

N79-23091# General Electric Co Lynn Mass Aircraft Engine Group
ASSESSMENT OF AUGMENTED ELECTRONIC FUEL CONTROLS FOR MODULAR ENGINE DIAGNOSTICS AND CONDITION MONITORING Final Report, Sep 1977 - Jun 1978
Daniel R Gilmore Jr Harold J Jordan and Alan D Pisano Dec 1978 149 p refs
(Contract DAAJ02-77-C-0065 DA Proj 1L2-62209-AH-76)
(AD-A065128 USARTL-TR-78-32) Avail NTIS HC A07/MF A01 CSCL 21/5

Fault isolation to the module and line replaceable unit (LRU) level by means of a Diagnostic and Condition Monitoring (D and CM) System integrated with a Full-Authority Digital Electronic Control (FADEC) is evaluated in this study A preliminary assessment of the D and CM system parameters required for performing the diagnostic functions on the current T700 engine is also included in the study Author (GRA)

N79-23092# Kaman Avidyne Burlington, Mass
WIND-TUNNEL SHOCK-TUBE SIMULATION AND EVALUATION OF BLAST EFFECTS ON AN ENGINE INLET Final Report, Oct 1975 - Dec 1977
J Ray Ruetenik and Robert F Smiley 15 Mar 1978 236 p refs
(Contract DNA001-76-C-0107)
(AD-A065388 AD-E300451 KA-TR-147 DNA-4590F) Avail NTIS HC A11/MF A01 CSCL 21/5

This report describes a program for simulating blast wave intercepts with a scaled aircraft engine in subsonic flight using the shock tube technique for firing the blast-type waves Three large 22 6 inch-diameter shock tubes were installed in the AEDC 16T (16 ft sq) transonic wind tunnel and were used to project blast waves at a 0 1-scale B-1 aircraft model Forty-five firings were made covering tunnel speeds of Mach 0 0 55 0 70 0 85 and 0 90 blast overpressures (scaled to 1 atm ambient pressure) from 2 to 6 psi 0 deg and 5 deg yaw and inlet flow rates representative of cruise and maximum power conditions The model inlets were instrumented with 40 combination steady-state and dynamic total-pressure probes at each engine face section and other dynamic transducers to measure incident blast wave properties and inlet internal ramp and cowl pressures Calculations of blast pressures in the inlets made with the KA BID code satisfactorily reproduced the principal features of the observed inlet duct and engine fact pressures Four potentially adverse effects to engine operation from blast interaction were identified blast-induced distortion fan choking afterburner blow-out and shock-boundary layer induced distortion GRA

N79-23093# Pratt and Whitney Aircraft Group West Palm Beach Fla Government Products Div
LO-FREQUENCY AUGMENTOR INSTABILITY INVESTIGATION COMPUTER PROGRAM USER'S MANUAL Report, 1 Mar 1976 - 1 Apr 1978
P L Russell G Brant and R Ernst 18 Dec 1978 307 p
(Contract F33615-76-C-2024)

(AD-A065774 PWA-FR-9797 AFAPL-TR-78-83) Avail NTIS HC A14/MF A01 CSCL 21/2

This report describes the computer code and the models developed to form the computer code used to analyze low frequency augmentor instability (rumble) Rumble occurs mainly at high fuel-air ratios and at flight Mach numbers and altitudes where low duct inlet air temperatures and pressures exist The model was developed in conjunction with and checked by two experimental programs GRA

N79-23094*# Pennsylvania State Univ University Park Applied Research Lab

THE EFFECTS OF DESIGN AND OPERATING VARIABLES ON THE RESPONSE OF AN AXIAL FLOW FAN TO INLET FLOW DISTORTIONS M S Thesis

Adam M Yocum II 14 Jun 1978 229 p refs

(Grant NsG-3031 Contract N00017-73-C-1418)

(AD-A058959 TM-74-15) Avail NTIS HC A11/MF A01 CSCL 13/1

This thesis presents the results of a study of total-pressure and velocity circumferential distortions in an axial-flow fan Distorted inlet flow is an important problem to the turbomachine designer because nonuniform and distorted flows cause noise vibration a reduction in efficiency and also a reduction in the stability limits for a multistage compressor Some of the sources of a nonuniform flow which are often unavoidable are wakes from upstream struts sharp bends in the inlet ducting flow separation in the inlet and vortices created by ingesting fluid from a boundary layer The present study was conducted to provide some of the fundamental experimental data needed to understand distorted flow phenomena as affected by design and operating variables The flow through an isolated rotor was examined at various operating conditions with six different distortions and three different blade stagger angles Circumferential surveys were conducted upstream and downstream of the rotor using five-hole probes in the non-nulling mode The measurements with the five-hole probes yielded the axial circumferential, and radial components of velocity and the total and static pressure GRA

N79-23095# Office National d Etudes et de Recherches Aerospatiales Modane (France)

AFTERBODY TESTS IN THE MODANE HOT GAS BENCH [ESSAIS D'ARRIERE-CORPS AU BANC DE GAZ CHAUD DE MODANE]

M Pletin and J M Hardy (SNECMA) Paris Assoc Aeron et Astronautique de France Nov 1977 21 p refs In FRENCH Presented at the 14th Colloq d Aerodyn Appl Toulouse 7-9 Nov 1977

(AAAF-NT-78-10 ISBN-2-7170-0495-5) Avail NTIS HC A02/MF A01 CEDOCAR Paris FF 17 (France and EEC) FF 21 (others)

With scale 1 10 models the Modane hot gas test bench was used to evaluate the internal performance of ejection systems for double flow jet engines at either high or low dilution rates Flow simulation with hot gas permits elimination of corrections used for cold jet mixtures at the outlet of double flow high dilution rate motors Since 1976 more than 800 tests were made on the afterbody of the CFM56 motor and other subjects with satisfactory results Author (ESA)

N79-23096# Bristol Univ (England) Dept of Aeronautical Engineering

THE TRAJECTORIES OF SPHERICAL PARTICLES IN FLOW THROUGH CASCADED TURNING VANES B S Thesis

A Hunt and N C Randle Jun 1978 74 p refs

(BU-220) Avail NTIS HC A04/MF A01

Work carried out on tracking salt particles through the inlet turning cascade of the Olympus marine gas turbine is described A method of theoretically tracking small spheres through a known field was developed and applied to the Olympus cascade assuming inviscid flow in an infinite cascade Using a 1/4 scale model of the cascade experimental measurements were taken to check the validity of the computed flow field The tracking calculation was applied to particles of salt and salt water with diameters ranging from 2 to 100 microns Results show that the cascade might be used as a filter for particles larger than 12 5 microns in diameter (for corrosion prevention) A formulation of the streamline curvature method for flow in a cascade is also presented Author (ESA)

N79-23097* National Aeronautics and Space Administration Langley Research Center Hampton Va

FILTERING TECHNIQUE BASED ON HIGH-FREQUENCY PLANT MODELING FOR HIGH-GAIN CONTROL Patent

Frank R Niessen and John F Garren Jr inventors (to NASA) Issued 10 Apr 1979 7 p Filed 8 Dec 1977 Supersedes N78-17070 (16 - 08 p 0980)

(NASA-Case-LAR-12215-1 US-Patent-4 148 452 US-Patent-Appl-SN-858762 US-Patent-Class-244-195 US-Patent-Class-244-17 13 US-Patent-Class-244-83G US-Patent-Class-318-585 US-Patent-Class-318-616, US-Patent-Class-364-434) Avail US Patent and Trademark Office CSCL 01C

This invention was an improvement in aircraft control systems that utilized feedback motion sensors to generate a signal to control the aircraft The improvement consisted essentially of a complementary filter comprising a simplified model of the aircraft a high pass filter a low pass filter and a summing amplifier The control signal was applied to the simplified model of the aircraft which attempted to compute the vehicle response to the signal This computed response was then fed into the high pass filter to eliminate long term errors in the calculated response with the result that a good estimate of the high frequency content of the aircraft motion was obtained In order to obtain a good estimate of the low frequency content of the motion a rate gyro signal was fed through the low pass filter that eliminates all of the offending noise

Official Gazette of the U S Patent and Trademark Office

N79-23098*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

A PILOTED SIMULATOR STUDY ON AUGMENTATION SYSTEMS TO IMPROVE HELICOPTER FLYING QUALITIES IN TERRAIN FLIGHT

Robert T N Chen Peter D Talbot Ronald M Gerdes and Daniel C Dugan Mar 1979 57 p

(NASA-TM-78571, A-7769) Avail NTIS HC A04/MF A01 CSCL 01C

Four basic single-rotor helicopters one teetering on articulated and two hingeless which were found to have a variety of major deficiencies in a previous fixed-based simulator study were selected as baseline configurations The stability and control augmentation systems (SCAS) include simple control augmentation systems to decouple pitch and yaw responses due to collective input and to quicken the pitch and roll control responses SCAS of rate-command type designed to optimize the sensitivity and damping and to decouple the pitch-roll due to aircraft angular tate and attitude-command type SCAS Pilot ratings and commentary are presented as well as performance data related to the task SCAS control usages and their gain levels associated with specific rotor types are also discussed L S

N79-23099*# Massachusetts Inst of Tech Cambridge

INVESTIGATION OF THE MULTIPLE METHOD ADAPTIVE CONTROL (MMAC) METHOD FOR FLIGHT CONTROL SYSTEMS Final Report

M Athans Y Baram D Castanon, K P Dunn C S Green W H Lee N R Sandell Jr, and A S Willsky May 1979 413 p refs

(Grant NsG-1018)

(NASA-CR-3089) Avail NTIS HC A18/MF A01 CSCL 01C

The stochastic adaptive control of the NASA F-8C digital-fly-by-wire aircraft using the multiple model adaptive control (MMAC) method is presented The selection of the performance criteria for the lateral and the longitudinal dynamics the design of the Kalman filters for different operating conditions the identification algorithm associated with the MMAC method the control system design, and simulation results obtained using the real time simulator of the F-8 aircraft at the NASA Langley Research Center are discussed J M S

N79-23100# Army Aviation Research and Development Command, St Louis Mo

STABILIZED TERRAIN OPTICAL POSITION SENSOR (STOPS) FLIGHT TEST REPORT

Christos M Tsoubanos Jan 1979 54 p refs

(AD-A065018, USAAVRADCOM-TR-79-1) Avail NTIS HC A04/MF A01 CSCL 01/3

This report presents the flight test results and evaluation of a brassboard model self-contained hover position sensor and obstacle clearing device The brassboard model of the self-contained absolute, position sensor referred as Stabilized Terrain Optical Postion Sensor (STOPS) was successfully installed and flown on the Avionics Research and Development Activity's Experimental Vehicle for Avionics Research (EVAR) project helicopter The results derived from the test indicate that position radial accuracies of better than 5 feet can be expected at constant (60 feet AGL) altitude For mission maneuvers such as the bob-up and remask, designed for the AAH position radial errors are in the order of 10 to 20 feet Author (GRA)

N79-23101# AiResearch Mfg Co, Torrance Calif

ELECTROMECHANICAL ACTUATION DEVELOPMENT Final Report, Feb 1976 - Sep 1978

Neal E Wood and Robert A Lewis Dec 1978 412 p (Contract F33615-76-C-3043)

(AD-A065734, AiResearch-78-15067 AFFDL-TR-78-150) Avail NTIS HC A18/MF A01 CSCL 01/3

Electromechanical actuation of primary flight control surfaces has been demonstrated by the development of an integrated rotary hinge-line dual-redundant actuation unit The characteristics of the developed hardware closely correlate with the design predictions A digital computer program was developed to simulate dynamic operation of the unit based upon the known equipment characteristics The system simulation results showed that the electromechanical actuation unit can meet selected performance goals Component compatibility system function performance capabilities and redundant operation were demonstrated using the laboratory hardware and computerized simulation analyses Author (GRA)

N79-23102# Air Force Human Resources Lab Wright-Patterson AFB Ohio

MOTION AND FORCE CUEING REQUIREMENTS AND TECHNIQUES FOR ADVANCED TACTICAL AIRCRAFT SIMULATION Final Report, Jul 1977 - Mar 1978

William B Albery Don R Gum and Gerald J Kron (Singer-Link Co, Binghamton N Y) Brooks AFB Tex Dec 1978 20 p refs

(AD-A064691 AFHRL-TR-78-73) Avail NTIS HC A02/MF A01 CSCL 01/3

The Air Force Human Resources Laboratory (AFHRL) has the responsibility for research and development of advanced simulation techniques including motion and force cueing requirements and techniques This report is a summary of the efforts currently underway at AFHRL under Projects 6114 and 1958 which are directed at advanced tactical aircraft simulation The approach being pursued is two-fold the first part includes efforts directed towards building a data base for use in developing cueing requirements the second part includes efforts to improve the performance of existing devices that have been shown to be somewhat effective and to develop new devices and techniques as indicated by the data base efforts Exploratory efforts including the development of a composite sensory model the design of high-g augmentation devices the development of a myoelectric feedback display dimming technique and the collection of g-cue environment data are discussed An advanced development effort the advanced g-cueing system (including g-sdat g-suit, and seat shaker) is highlighted Author (GRA)

N79-23103# Army Aviation Engineering Flight Activity Edwards AFB Calif

FLIGHT EVALUATION MK 2 INTEGRATED CONTROLLER INSTALLED IN AN OH-58A HELICOPTER Final Report

John F Hagen, Patrick J Moe, and Ralph Woratschek Apr 1978 66 p refs

(AD-A065072 USAAEFA-77-11) Avail NTIS HC A04/MF A01 CSCL 01/4

This activity conducted a limited handling q ralities and pilot workload evaluation of the MK II integrated controller installed in an OH-58A helicopter The evaluation consisted of 22 flights for 15 2 hours of productive flight test time The OH-58A could be safely flown throughout the recommended flight envelope using the integrated controller The pilot workload when using the integrated controller with two hands was not reduced from and was sometimes greater than the workload when using conventional controls for all maneuvers except level forward flight Single hand control during flight and landing could be safely accomplished, but required increased pilot workload in all cases The two most serious unsatisfactory characteristics identified were lack of an adequate system-decoupled warning and excessive workload during left sideward flight between approximately 15 to 25 knots true airspeed Three unsatisfactory characteristics that contributed to the increased workload when using the integrated controller were excessive longitudinal and lateral integrated controller response and sensitivity lack of control displacement harmony between the integrated controller cyclic and collective controls, and inadvertent cyclic control inputs with collective control movement The reduced longitudinal and lateral control authority which limited the aircraft s forward flight capability at aft center of gravity rearward flight capability at forward center of gravity and slope landing capability was also an unsatisfactory characteristic Eight additional unsatisfactory characteristics were also identified GRA

N79-23104# Societe Nationale Industrielle Aerospatiale Paris (France)

BUFFETING MEASUREMENTS IN FLIGHT AND IN A WIND TUNNEL [MESURES DE TREMBLEMENT EN VOL ET EN SOUFFLERIE]

C Havette and J Mandle Paris Assoc Aeron et Astronautique de France 1977 21 p refs In FRENCH Presented at the 14th Colloq d Aerodyn Appl Toulouse 7-9 Nov 1977 Sponsored by Serv Tech de l Aeron Prepared jointly with ONERA Modane France

(AAAF-NT-78-17 ISBN-2-7170-0502-1) Avail NTIS HC A02/MF A01 CEDOCAR Paris FF 17 (France and EEC) FF 21 (others)

The buffeting effect on a 1 10 scale model in a wind tunnel was compared with in-flight measurements taken on a T-33 aircraft either with a standard NACA = 65213a = 0 5 wing profile or an S17a wide supercritical profile in order to determine if real flight conditions can be estimated in wind tunnel tests The model and aircraft were provided with several methods for buffeting measurement such as wall static pressure distribution Kulite-type pressure sensors adapted to unsteady measurements (four on the aircraft) wake exploration devices that permit comparison of profiles Cx with those of two-dimensional tests accelerometers and flexometers Preliminary results show that buffeting can be predicted from wind tunnel tests and that special analyses are similar for flight and wind tunnel conditions Author (ESA)

N79-23105# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

LARGE TRANSONIC WIND TUNNELS

1973 418 p refs Lecture held at Rhode-Saint-Genese Belgium 29 Jan 1973 - 2 Feb 1973

(VKI-Lecture-Series-52) Avail NTIS HC A18/MF A01

The design and construction of large transonic facilities are described with emphasis on wind tunnel drives, models test procedures and time requirements for measurements

N79-23106# Office National d Etudes et de Recherches Aerospatiales Paris (France)

THE INJECTOR DRIVEN TUNNEL

Pierre Carriere *In* Von Karman Inst for Fluid Dyn Large Transonic Wind Tunnels 1973 61 p refs

Avail NTIS HC A18/MF A01

Specific problems attached to an injector driven tunnel are examined with emphasis on (1) methods for evaluating and optimizing its performance in permanent regime (2) analysis of unsteady phenomena during the wind tunnel start and (3) problems of intense noise generated by the jets Some general indications are presented on the orders of magnitude of certain basic technological data Section 8 4 of the LaWs Group final report (January 1973) which summarizes the main proposals for the base features of the project of a transonic industrial IDT satisfying the LaWs Group specifications is included A R H

N79-23107# Institut Aerotechnique de Saint-Cyr Saint-Cyr-l Ecole (France)
HYDRAULIC COMPRESSOR FOR A WIND TUNNEL [SOUFFLERIE A COMPRESSEUR HYDRAULIQUE]
Maurice Menard *In* Von Karman Inst for Fluid Dyn Large Transonic Wind Tunnels 1973 15 p refs In FRENCH

Avail NTIS HC A18/MF A01
The basic thermodynamic cycle for a wind tunnel drive is discussed and procedures for its installation in a transonic wind tunnel are described to illustrate both system operation and efficiency Technical solutions are presented for more economical construction of the projected apparatus and well as for the jet itself Drawings are given for a 5 m x 4 20 wind tunnel
Transl by A R H

N79-23108# Institut Aerotechnique de Saint-Cyr, Saint-Cyr-l'Ecole (France)
THE PRIMING OF A WIND TUNNEL WITH A HYDRAULIC COMPRESSOR [ETUDE DE L'ANORCAGE D'UNE SOUFFLERIE A COMPRESSEUR HYDRAULIQUE]
Francis Chometon *In* Von Karman Inst for Fluid Dyn Large Transonic Wind Tunnels 1973 10 p refs

Avail NTIS HC A18/MF A01
The more or less rapid opening of a valve to permit air entry into a wind tunnel causes an expansion wave which is propagated at the speed of sound and is reflected from the walls of the chamber back towards the water downstream from it is reflected back towards the walls of the upstream chamber until it is completely absorbed The nature of these perturbations and means for reducing the intensity of these parasitic waves were investigated Results of numerical calculations and experiments conducted to determine the influence of flow geometry are discussed Transl by A R H

N79-23109# Office National d Etudes et de Recherches Aerospatiales Toulouse (France)
EFFECTS OF FLOW TURBULENCE AND NOISE ON AERODYNAMIC PHENOMENA AND MEASURED QUANTITIES
R Michel *In* Von Karman Inst for Fluid Dyn Large Transonic Wind Tunnels 1973 8 p refs In FRENCH

Avail NTIS HC A18/MF A01
The influence of different instabilities on wind tunnel flow are examined with emphasis on both supersonic and transonic boundary layer transition as well as the development of the turbulent boundary layer Implications for aerodynamic coefficients obtained in wind tunnel tests are discussed Transl by A R H

N79-23110# Royal Aircraft Establishment Bedford (England) Aerodynamic Dept
THE DESIGN OF MODELS AND THEIR SUPPORTS, THE EVANS CLEAN-FLOW TUNNEL A REVIEW OF SOME OF THE VARIOUS PROPOSALS
P G Pugh *In* Von Karman Inst for Fluid Dyn Large Transonic Wind Tunnels 1973 51 p refs

Avail NTIS HC A11/MF A01
In the interests of economy a wind tunnel designer will favor increasing the pressure (rather than the size) as a means of attaining high Reynolds numbers The implications of the strength and aeroelastic distortions of wind tunnel models and their supports on the design of high Reynolds number wind tunnels are examined Operating principles are described for the Evans clean flow tunnel in which the settling chamber of a conventional wind tunnel is extended as a long tube Air is allowed to settle quietly in this tube before the start of a run during which it is pushed through the test section by a moving piston along the tube Various experiments conducted to demonstrate its effectiveness are reviewed Proposed drive systems for high Reynolds number transonic wind tunnels are examined A R H

N79-23111# ARO, Inc Arnold Air Force Station, Tenn
EXPERIMENTAL STUDIES IN A LUDWIEG TUBE TRANSONIC TUNNEL
C J Schueler (Von Karman Inst of Fluid Dynamics) *In* Von Karman Inst for Fluid Dyn Large Transonic Wind Tunnels 1973 43 p refs Sponsored in part by USAF

Avail NTIS HC A18/MF A01
The feasibility of obtaining high Reynolds numbers in a transonic wind tunnel with a Ludweig tube drive system was investigated using a 1/13-scale model of a high Reynolds transonic facility The studies conducted included measurement and analysis of (1) boundary layers in the charge tube (2) entrance to the nozzle and in the test section, (3) tunnel start time (4) test section Mach number flow uniformity (5) flow response time (6) pressure distributions on a two-dimensional airfoil model (7) force measurements on cones (8) the influence of plenum volume and (9) the acoustics of the exhaust system
A R H

N79-23112# National Aerospace Lab Amsterdam (Netherlands)
NOTES CONCERNING TESTING TIME REQUIREMENTS IN STEADY AND UNSTEADY MEASUREMENTS
J W G vanNunen *In* Von Karman Inst for Fluid Dyn Large Transonic Wind Tunnels 1973 12 p

Avail NTIS HC A18/MF A01
Stationary wind tunnel measurements are needed to support theoretical calculations and to present information in cases where theory is expected to fail Among those there are effects at transonic speeds especially interaction between various large bodies and shock wave-boundary layer interaction influence of Reynolds number and separation of flow Information can be obtained in two ways either by overall force and moment measurements or by pressure measurements In both cases a model will in principle be sting-mounted to reduce the interference effects as much as possible Instationary pressure distribution induced by harmonic motions of the model are measured by pressure tubes or in situ transducers Accelerometers mounted on the model measure its vibrational modes and are used to analyze flutter and and measure buffeting A R H

N79-23113# Avions Marcel Dassault-Breguet Aviation Saint-Cloud (France) Aerodynamics Dept
WALL INTERFERENCE EFFECTS
Jean-Ch Vayssaire *In* Von Karman Inst for Fluid Dyn Large Transonic Wind Tunnels 1973 48 p refs

Avail NTIS HC A18/MF A01
A survey of the methods used to correct the wind tunnel model results for wall effect cannot be restricted to the study of the walls If the walls act on the model the wall action is affected by the general arrangement of the wind tunnel The shape of the section or the length of the test section are important parameters When considering only aerodynamic criteria the following parameters must be positively known reference kinetic pressure reffered to as upstream pressure distribution of velocities and static pressures wind ascendance etc Furthermore air temperature shall be noted and relative humidity taken into account Due allowance must be made for interactions caused by the supporting means i e struts or stings These interactions are either direct in relation to the model or indirect due to the wall effect on the supporting means which acts in turn on the model Therefore the working section is considered to be affected by all the elements placed upstream or downstream A R H

N79-23114*# DCW Industries Studio City Calif
USER GUIDE FOR STRMLN A BOUNDARY-LAYER

PROGRAM FOR CONTOURED WIND-TUNNEL LINER DESIGN Final Report

E Clay Anderson May 1979 52 p refs
(Contract NAS1-14517)
(NASA-CR-159058 DCW-R-15-02) Avail NTIS HC A04/MF A01 CSCL 14B

A 2-D boundary layer computer code developed to process data for an arbitrary number of streamlines is presented Provisions are included for the computer code to determine either mass transfer rates necessary for an effective boundary layer displacement of zero thickness or the effective displacement thickness for a specified mass transfer-rate distribution The computer code was developed to be compatible with other computer codes which are being modified and/or developed at the NASA-Langley Research Center in order to design the three dimensional contoured wind tunnel liner used in transonic testing of a laminar flow control system installed on a supercritical airfoil section A brief discription of the liner design procedure representative liner calculations, adaptive-wall design for a two dimensional wind tunnel test and other applications are reported Author

N79-23115# San Diego Aircraft Engineering Inc Calif

TEST PLAN FOR A ONE-HALF SCALE LABORATORY MODEL OF A RIGID SKIRT HOLD-DOWN SYSTEM Interim Report

P Sorensen 29 Sep 1978 21 p
(Contract N62269-78-M-8646 WF41411000)
(AD-A065171 SAE-78-027 NADC-79027-20) Avail NTIS HC A02/MF A01 CSCL 01/3

This report is a proposed test plan to obtain the data needed to project and evaluate the performance of a full scale system Key issues of the planned testing include air bearing seal leakage rates loss of hold-down force while traversing flight deck obstacles (tie-down fittings, door seals etc) and the magnitude of towing drag forces encountered during traversing In addition to the test plan, data requirements and test equipment/apparatus requirements are addressed GRA

N79-23116# Societe Bertin et Cie Villeurbanne (France)

TWO DIMENSIONAL ANEMOMETRIC PROBE [NOUVELLE SONDE ANEMOMETRIQUE BIDIMENSIONNELLE]

M Lepretre Paris Assoc Aeron et Astronautique de France 1977 30 p refs In FRENCH Presented at the 14th Colloq d Aerodyn Appl Toulouse 7-9 Nov 1977
(AAAF-NT-78-09, ISBN-2-7170-0494-7) Avail NTIS HC A03/MF A01 CEDOCAR, Paris FF 29 (France and EEC) FF 33 (others)

A cylindrical miniaturized anemometric probe having operational and cost advantages for measuring air velocity (intensity and direction) around a given point is described It consists of a set of four steel tubes with lateral orifices immersed in a cylindrical resin block The small probe can sense velocity direction from the differences between the four measuring devices and is mounted so that the cylinder axis is transversal to fluid flow Displacing the probe linearly a velocity diagram is obtained This operation is repeated in different positions to construct a complete two-dimensional flow distribution pattern Application examples and suggestions for improvement are discussed Author (ESA)

N79-23117# Institut Franco-Allemand de Recherches, St Louis (France)

OPTICAL FLOW MEASUREMENTS APPLICATIONS TO WIND TUNNELS OR MOTOR BENCH TESTS [MESURES OPTIQUES DANS LES ECOULEMENTS APPLICATION AU SOUFFLERIE OU AUX BANCS D'ESSAIS DE MOTEURS]

X Bouis (ONERA) Paris Assoc Aeron et Astronautique de France 1977 57 p refs In FRENCH Presented at the 14th Colloq d Bdrondyn Appl Toulouse 7-9 Nov 1977 Prepared jointly with ONERA Modane France
(AAAF-NT-78-07 ISBN-2-7170-0492-0) Avail NTIS HC A04/MF A01, CEDOCAR Paris FF 29 (France and EEC) FF 33 (others)

The optical flow measuring methods surveyed include integral methods such as interferometry and spectroscopy and point methods, suc as laser anemometry, Raman effect and Rayleigh diffusion The principle resolution in time and space uses, and limitations are discussed for each method It is concluded that point measurements are limited by signal level Only laser anemometry using by far the strongest signals can reach a better than 1% precision on instant measurements Integral methods are limited to two-dimensional flow Cases of specific application of optical methods are reviewed Author (ESA)

N79-23118# Association Aeronautique et Astronautique de France Paris

EUROPEAN TRANSONIC WIND TUNNEL PROJECT FOR HIGH REYNOLDS NUMBERS [PROJECT DE SOUFFLERIE TRANSSONIQUE EUROPEENE A GRAND NOMBRE DE REYNOLDS]

J Christophe Nov 1977 34 p refs In FRENCH Presented at the 14th Colloq d Aerodyn Appl Toulouse 7-9 Nov 1977
(AAAF-NT-78-01 ISBN-2-7170-0486) Avail NTIS HC A03/MF A01 CEDOCAR, Paris FF 29 (France and EEC) FF 33 (others)

Work from 1968 to the final joint recommendation to build a cryogenic transonic high Reynolds number wind tunnel for European governments is discussed Such a project is necessary since actual flight performance differs from low Reynolds number transonic wind tunnel results Several alternatives were proposed and experimentally tried in pilot essays The cryogenic solution was finally recommended as static pressure and power can be kept low for the same Reynolds number The proposed wind tunnel is 1 95 x 1 65 sq m with maximum pressure at 4 4 Bars minimum temperature at 120K Mach number up to 1 35 and Reynolds number up to 40 million when working with nitrogen instead of air Author (ESA)

N79-23119# Association Aeronautique et Astronautique de France Paris

EFFECT OF THE MODEL VERTICAL POSITION IN A SLOTTED WALL WIND TUNNEL [EFFET DE LA POSITION EN HAUTEUR D'UNE MAQUETTE DANS UNE SOUFFLERIE A PAROIS PERMEABLES A FENTES]

C vandeKreeke (Aerospatiale) Nov 1977 24 p refs In FRENCH Presented at the 14th Colloq d Aerodyn Appl Toulouse 7-9 Nov, 1977
(AAAF-NT-78-05 ISBN-2-7170-0490-4) Avail NTIS HC A02/MF A01 CEDOCAR Paris FF 17 (France and EEC) FF 21 (others)

The forces acting on a model in the vertical position in a slotted wall transonic wind tunnel were measured This influence was measured at Mach 0 2 to 0 25 near the upper wall of the wind tunnel Results show that wall effects are significant as the model is positioned further away from the flow axis Tests for positions vertically departing from the flow axis are required as well as additional measurements to furnish the necessary corrections Author (ESA)

N79-23120# Association Aeronautique et Astronautique de France Paris

SIMILITUDE, MANUFACTURING, IDENTIFICATION, AND INSTRUMENTATION OF TEST MODELS [SIMILITUDE, REALIZATION, IDENTIFICATION, ET INSTRUMENTATION DES MAQUETTES D'ESSAIS]

F Dupriez (Univ des Sci et Tech de Lille) 1977 38 p refs In FRENCH Presented at the 14th Colloq d Aerodyn Appl Toulouse 7-9 Nov 1977
(AAAF-NT-78-24 ISBN-2-7170-0509-9) Avail NTIS HC A03/MF A01 CEDOCAR Paris FF 29 (France and EEC) FF 33 (others)

Several aspects of present aircraft model technology are surveyed Similitude and practical choice rules are discussed as well as identification and instrumentation techniques Specifications and manufacturing are illustrated with several practical examples such as use of high technology composite materials (carbon and boron fibers) increasing application of numerical control manufacturing techniques the rapid development of microprocessor use and adaptation to basic technological changes such as cryogenic wind tunnels Author (ESA)

N79-23121# Avions Marcel Dassault-Breguet Aviation Saint-Cloud (France)

IMPROVEMENT OF THE AERODYNAMIC CIRCUIT IN THE BREGUET-VELIZY LOW SPEED WIND TUNNEL [MODERNIZATION DE LA SOUFFLERIE BASSE VITESSE BREGUET DE VELIZY AMELIORATION DU CIRCUIT AERODYNAMIQUE]

C Couedor Paris Assoc Aeron et Astronautique de France 1977 24 p In FRENCH Presented at the 14th Colloq d Aerodyn Appl Toulouse 7-9 Nov 1977

(AAAF-NT-78-11 ISBN-2-7170-0496-3) Avail NTIS HC A02/MF A01 CEDOCAR Paris FF 17 (France and EEC) FF 21 (others)

In an Eiffel-type rectangular semi-guided (3 8 x 3 07m) wind tunnel, used normally at 37 m/s 30 modifications aimed at reducing macroturbulence problems were tested A total of 400 combination tests were performed on a reduced scale and five devices were selected The modification of the wind tunnel was carried out in January 76 Improvement of the aerodynamic circuit resulted in increased test reliability and precision

Author (ESA)

N79-23122# Association Aeronautique et Astronautique de France Paris

MODERNIZATION OF THE LOW SPEED WIND TUNNEL AT BREGUET DE VELIZY MEASURING SYSTEM MODERNIZATION [MODERNISATION DE LA SOUFFLERIE BASSE VITESSE BREGUET DE VELIZY MODERNISATION DES MOYENS DE MESURE]

G Pierron Paris Assoc Aeron et Astronautique de France 1977 26 p refs In FRENCH Presented at the 14th Colloq d Aerodyn Appl Toulouse 7-9 Nov 1977

(AAAF-NT-78-12 ISBN-2-7170-0497-1) Avail NTIS HC A03/MF A01 CEDOCAR, Paris FF 17 (France and EEC) FF 21 (others)

To improve measuring precision and processing speed, a new system was developed based on the TI980A Design hardware and programming criteria are discussed Dispersion of data in the improved system is + or - 0 04% on drag coefficient measurements + or - 0 4% on lift and + or - 0 15% on roll for classic airplanes The new processing and recording time is 4 to 5 min to obtain a polar analysis, 0 to 30 deg Idle wind tunnel time because of measuring system failure was 4 days in 3 *yrs working full time* *Author (ESA)*

N79-23123# Laboratoire de Recherches Balistiques et Aerodynamiques Vernon (France)

IMPROVEMENTS ON THE C4/VERNON WIND TUNNEL [AMELIORATIONS DE LA SOUFFLERIE C4/VERNON]

Jean-Pierre Bernheim Paris Assoc Aeron et Astronautique de France 1977 34 p refs In FRENCH Presented at the 14th Colloq d Aerodyn Appl , Toulouse 7-9 Nov 1977

(AAAF-NT-78-13 ISBN-2-7170-0498-x) Avail NTIS HC A03/MF A01 CEDOCAR Paris FF 29 (France and EEC) FF 33 (others)

Improvements were made to extend the range of applications to include transonic flow and to incorporate new measuring devices For transonics the flow section was reduced limiting the height to 350 mm including perforated walls Pressure drop studies were made to determine the influence of model size and positivn on the permeability factor Complementary improvements are programmed Among the new measuring devices are three 6-component balances and one double beam balance to measure forces on a 20 mm wing model Feasibility of a magnus effect balance has been demonstrated and construction is in progress Author (ESA)

N79-23124# Association Aeronautique et Astronautique de France Paris

CONSTRUCTION PROBLEMS SPECIFIC TO MODELS FOR HIGH REYNOLDS NUMBER WIND TUNNELS [PROBLEMES DE CONSTRUCTION DE MAQUETTES POUR LES SOUFFLERIES A GRAND NOMBRE DE REYNOLDS]

M Bazin 1977 45 p refs In FRENCH Presented at the 14th Colloq d Aerodyn Appl Toulouse 7-9 Nov 1977

(AAAF-NT-78-02 ISBN-2-7170-0487-4) Avail NTIS HC A03/MF A01 CEDOCAR Paris FF 29 (France and EEC) FF 33 (others)

The state-of-the-art is surveyed for both pressurized and cryogenic wind tunnel alternatives Materials feasible dimensions saftey problems cost instrumentation etc are discussed by model construction experts Feasibility is demonstrated although an effort to reduce developing time is still necessary Present limitations include balances and model supports New methods or materials will be necessary to replace local gages in the case of cryogenic systems Author (ESA)

N79-23125# Bristol Univ (England) Dept of Aeronautical Engineering

THE EFFECT OF BLOCKAGE IN SHEAR FLOW IN THE WIND TUNNEL B S Thesis

P P Kirrane and S J Stewart Jun 1978 33 p refs (BU-221) Avail NTIS HC A03/MF A01

In an attempt to isolate and quantify the effects of blockage in shear flow the pressure fields around two-dimensional Gaussian hills in an industrial wind tunnel were measured The results obtained were compared with computed results for an unbounded turbulent shear flow It was found that blockage errors were masked by limitations in the boundary layer simulation for blockages of less than 10 percent Author (ESA)

N79-23181# Purdue Univ , Lafayette, Ind School of Mechanical Engineering

IGNITION OF FUEL SPRAYS BY HOT SURFACES AND STABILIZATION OF AIRCRAFT FIRES Interim Report, 1 Oct 1977 - 15 Nov. 1978

J G Skifstd, A H Lefebvre D R Ballal K R Sarsteder and M S Kelly Nov 1978 51 p refs

(Grant AF-AFOSR-3446-77)

(AD-A065153, AFOSR-79-0079TR) Avail NTIS HC A04/MF A01 CSCL 01/2

This first annual report discusses a research project undertaken to investigate experimentally and theoretically the ignition of fuel sprays by hot surfaces and the stabilization of aircraft fires related to aircraft fire safety The basic problems are outlined and the experimental facilities developed for the research are described along with a discussion of operating experience to date

Author (GRA)

N79-23219# Naval Surface Weapons Center White Oak, Md

POLYURETHANE FOAMS FOR AIRCRAFT SHOCK MOUNTS 2 POLYBUTADIENE BASED FOAMS Progress Report, Oct 1977 - Jun 1978

Hubert J Booth and James V Duffy Nov 1978 72 p refs (AD-A064859, NSWC/WOL/TR-78-162) Avail NTIS HC A04/MF A01 CSCL 11/9

The objective of this program was to develop flexible foam systems which meet the specifications outlined in MIL-F-81334B (AS) This report deals with the results obtained from a series of foams based on polybutadient polyol and its combinations with various types of polyether polyols Polyol ratios surfactant type and concentration, and catalyst type and concentration were evaluated to determine their influence on foam properties Those foams demonstrating the most promise were measured for density, compression set rebound tensile strength elongation hydraulic fluid and hydrolytic resistance porosity and vibration damping

Author (GRA)

N79-23227# Bristol Univ (England) Dept of Aeronautical Engineering

ANALYSIS OF THE MECHANICAL PROPERTIES OF RIGID FOAMS WITH PARTICULAR CONSIDERATION OF A RIGID POLYETHER STRUCTURAL FOAM B S Thesis

A J Beckett and P T Waller Jun 1978 74 p refs (BU-229) Avail NTIS HC A04/MF A01

A preliminary investigation was made into the mechanical properties (tension compression shear torsion and two types of bending) of rigid structural foams with particular interest in rigid polyether foam While seemingly accurate values of Young s modulus and shear modulus were obtained for each test there was considerable variation in values between the tests Three

principal values of Young s modulus were obtained In tension tests the values gave a mean of 13 5 N/sq mm in compression a mean value of 20 8N/sq mm The values of shear modulus obtained from the shear and torsion tests were both approximately 10 0 N/sq mm While no theory could be found to relate the different values of Young's modulus the foam was thought to be isotropic Poisson s ratio was found to be 0 19 Author (ESA)

N79-23232# Department of Energy Bartlesville Okla Energy Research Center
THERMODYNAMICS OF ORGANIC COMPOUNDS Final Technical Summary Report, 1 Oct 1977 - 30 Sep 1978
William D Good Donald W Scott Norris K Smith Susan Lee-Bechtold and Ann G Osborn 30 Sep 1978 27 p refs (AFOSR-ISSA-78-0009)
(AD-A065664 AFOSR-79-0197TR) Avail NTIS HC A03/MF A01 CSCL 21/4

Both basic and applied research continued on the thermodynamic properties of currently used high energy fuels and of possible constituents of high energy fuels of the future Enthalpies of combustion were measured for two ramjet fuels currently in use and differential scanning calorimetry evaluated heat capacities of four such fuels Enthalpies of combustion were measured for two pure organic compounds having the energetic cyclobutane ring in their molecular structure and the study of compounds that may have higher combustion energies because of steric interaction of adjacent alkyl groups was continued with vapor pressure study on dialkylnaphthalene Author (GRA)

N79-23236# Advisory Group for Aerospace Research and Development Paris (France)
ADVANCED FABRICATION PROCESSES
Mar 1979 258 p refs In ENGLISH and FRENCH Presented at the 47th Meeting of AGARD Struct and Mater Panel, Florence, 26-28 Sep 1978
(AGARD-CP-256 ISBN-92-835-0227-2) Avail NTIS HC A12/MF A01

The purpose of the specialists meeting was threefold Most importantly it was to elucidate on some specific high payoff new processing concepts selected from a cross-section of NATO nations This broad base of coverage was invaluable in itself but also was intended to aid in steering the Structures and Materials Panel toward selection of specific new areas where data and information interchange in much greater depth would be beneficial The third purpose was to promote a coupling of the fundamental research activities to more applied efforts

N79-23242# Royal Aircraft Establishment, Farnborough (England) Materials Dept
AN EVALUATION OF COATINGS FOR STEEL AND TITANIUM ALLOY FASTENERS FOR AIRCRAFT APPLICATIONS
V C R McLoughlin *In* AGARD Advan Fabric Processes Mar 1979 11 p refs

Copyright Avail NTIS HC A12/MF A01

To evaluate their use as alternatives to cadmium on bolts the properties of various coatings were examined Judged by marine atmosphere exposure the corrosion resistance of the coated bolts varied from excellent (cadmium and zinc plate) to negligible their galvanic compatibility with aluminium alloy showed similar variations The results of laboratory tests to evaluate these corrosion characteristics conflicted with the marine atmosphere tests The measurement of the currents generated and weight losses which occurred in galvanic cells between the bolts and aluminum alloy electrodes is shown to be a useful and very rapid screening test for galvanic compatibility The uniformity of the coatings was established metallographically and various properties of the coatings examined include fluid resistance paint adhesion properties, electrical conductivity and resistance to thermal shock The effect of the coatings on the fatigue properties and torque-tension characteristics of the bolts were also assessed J A M

N79-23251# Rockwell International Corp Los Angeles Calif Advanced Titanium Technology Div
CONCURRENT SUPERPLASTIC FORMING/DIFFUSION BONDING OF B-1 COMPONENTS
George W Stacher and Edward D Weisert *In* AGARD Advan Fabric Processes Mar 1979 10 p refs

Avail NTIS HC A12/MF A01

A process that combines both superplastic forming and diffusion bonding of titanium is discussed Trade studies using this technology in actual applications show that this combined process results in cost savings up to 60% when compared to conventional titanium construction methods while also saving weight The evolution of these titanium fabrication methods came about because of the necessity to improve aircraft performance and reduce cost of ownership Applications include single-sheet formed parts selectively formed and bonded hollow sections and complex sandwich structure replacing multiple-piece assemblies and machined parts A total of 26 different titanium configurations were produced and installed on the B-1 Cost reductions and weight savings in all cases have averaged between 30 and 50% when compared to previous construction M M M

N79-23252# British Aerospace Aircraft Group Bristol (England)
FABRICATION OF TITANIUM AT HIGH TEMPERATURES
S J Swadling *In* AGARD Advan Fabric Processes Mar 1979 17 p
Avail NTIS HC A12/MF A01

Forming techniques of titanium and titanium alloys are presented The applications of the technology in aircraft component manufacture is discussed Cost estimates and production methods are given M M M

N79-23254# Fiat Research Center Orbassano (Italy)
HEAT TREATMENT OF P/M NICKEL-BASE SUPERALLOYS FOR TURBINE DISKS
P L Antona and A Bennani *In* AGARD Advan Fabric Processes Mar 1979 20 p
Avail NTIS HC A12/MF A01

The microstructure of a superalloy produced from pre-alloyed powder using the hot isostatic pressing process is presented This superalloy makes subsequent heat treatment simpler and enables mechanical characteristics to be obtained which are comparable with superalloys produced using conventional technologies M M M

N79-23257*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
IDENTIFICATION AND DUAL ADAPTIVE CONTROL OF A TURBOJET ENGINE
Walter Merrill and Gary Leininger (Toledo Univ) 1979 10 p refs Proposed for presentation at the 5th IFAC Symp on Identification and System Parameter Estimation Darmstadt West Ger 24-28 Sep 1979
(NASA-TM-79145 E-10000) Avail NTIS HC A02/MF A01 CSCL 21E

The objective of this paper is to utilize the design methods of modern control theory to realize a dual-adaptive feedback control unit for a highly nonlinear single spool airbreathing turbojet engine Using a very detailed and accurate simulation of the nonlinear engine as the data source linear operating point models of unspecified dimension are identified Feedback control laws are designed at each operating point for a prespecified set of sampling rates using sampled-data output regulator theory The control system sampling rate is determined by an adaptive sampling algorithm in correspondence with turbojet engine performance The result is a dual-adaptive control law that is functionally dependent upon the sampling rate selected and environmental operating conditions Simulation transients demonstrate the utility of the dual-adaptive design to improve on-board computer utilization while maintaining acceptable levels of engine performance Author

N79-23260# Army Construction Engineering Research Lab Champaign, Ill

SYSTEMS APPROACH TO LIFE-CYCLE DESIGN OF PAVEMENTS VOLUME 3 LIFE2 PROGRAM LISTING
Final Report

Edward S Lindow Oct 1979 454 p refs
(DA Proj 4A7-63734-DT-08)
(AD-A064698, CERL-TR-M-253-Vol-3) Avail NTIS HC A20/MF A01 CSCL 13/2

This report is the third volume of a three-volume report which documents an automated system (LIFE2) for analyzing pavement designs and maintenance and repair strategies based on life-cycle costs LIFE2 models existing Corps of Engineers criteria for designing rigid and flexible pavements for airfields, roads, and streets The program includes analytical procedures for evaluating earthwork drainage and frost protection requirements in addition to maintenance costs The resulting combinations of design schemes and maintenance strategies are ranked by total cost over the design life of the pavement Volume I is the LIFE2 Users Manual Volume II is the LIFE2 System Documentation and Volume III is the LIFE2 Program Listing Author (GRA)

N79-23261# Naval Ship Research and Development Center Bethesda Md Ship Performance Dept

PERFORMANCE OF A TAP-2 HYDROFOIL

Pierre Lafrance Jun 1978 105 p refs
(AD-A065102, DTNSRDC/SPD-0843-01) Avail NTIS HC A06/MF A01 CSCL 13/10

This report discusses the measured performance of the TAP-2 hydrofoil, a mixed foil designed to operate fully wetted at takeoff (35 knots) and which through a change in geometry can fly fully ventilated at cruise speed (60 knots) At takeoff TAP-2 has a lift-to-drag ratio of 13 at the design lift coefficient, the corresponding figure for cruise speed is between 7 and 8 Predictive extrapolation to prototype scale is discussed and contrasted with our present understanding of the scaling laws associated with ventilation Author (GRA)

N79-23318# Army Missile Research and Development Command Redstone Arsenal Ala Technology Lab

RADAR TRACK DATA CORRELATION OR REACHABLE SETS REVISITED THE REACHABLE STATE

Richard E Dickson 31 Jul 1978 31 p refs
(AD-A065045 DRDMI-T-78-61) Avail NTIS HC A03/MF A01 CSCL 17/9

Given an aircraft s position and velocity at time t sub 0 and the limits on the rate at which the aircraft executes horizontal turns what is the set of all possible position at time t given the change in heading at time t and that the speed is unchanged Author (GRA)

N79-23331# Syracuse Univ N Y

STUDY OF RADC NEWPORT ANTENNA TEST RANGE METHODS OF REFLECTION REDUCTIONS AND INCREASED FREQUENCY COVERAGE

J Perini and B Silverman Jan 1979 71 p
(Contract F30602-75-C-0121)
(AD-A065151 RADC-TR-78-262) Avail NTIS HC A04/MF A01 CSCL 14/2

In this report a study of the short and long antenna ranges at the RADC/NEWPORT site is undertaken with the objectives of extending its frequency of operation from 2 GHz down to 200 MHz and from 18 GHz up to 40 GHz In the report the problem of ground reflections is studied and two solutions are proposed A short term solution was that of constructing ground fences and a long term solution which consists of processing the signal received using digital signal processing techniques to eliminate the reflections The ground fences have been constructed and the improvement is documented by measurements before and after the fences were installed As for the digital signal processing a theoretical study is carried out A feasibility study of its implementation is recommended Instrumentation needs for the extension of the site frequency range is also included in the report Author (GRA)

N79-23378# Southampton Univ (England) Inst of Sound and Vibration Research

AERODYNAMIC NOISE THEORY

P A Lush *In* Von Karman Inst for Fluid Dyn Advan in Turbulent Shear Flows Mar 1973 34 p

Avail NTIS HC A20/MF A01

Lighthill s acoustic analogy is reviewed and an attempt is made to reformulate the source function so that the resulting noise estimates are relatively independent of a detailed knowledge of the flow field Expressions are developed for the far-field acoustic pressures due to the distributed arrays of fluctuation mass addition fluctuating forces, and fluctuating stresses Assuming that these casual effects occur in typical turbulent flows the observed properties of turbulent flows are used to investigate the parametric dependences of the noise fields generated The estimated aerodynamic noise sources are then applied to jet flows Practical results show that theory grossly over-predicts high frequency noise particularly at high speeds and small angles to the jet axis and the peak frequency at these smaller angles is virtually independent of jet velocity rather than proportional to it as predicted by theory Causes of these discrepancies are suggested A R H

N79-23379# Southampton Univ (England) Inst of Sound and Vibration Research

JET NOISE A STATUS REPORT

P A Lush *In* Von Karman Inst for Fluid Dyn Advan in Turbulent Shear Flows Mar 1973 26 p refs

Avail NTIS HC A20/MF A01

Major investigations were conducted in a recently constructed jet noise facility to measure the noise produced by the turbulent mixing of gases downstream of the nozzle exit plane the additional noise arising from the presence of shock waves in the jet exha rst, and the excess tailpipe noise arising either from within the engine or generated at the nozzle exit plane because of engine promoted flow disturbances Specific attention was given to (1) the cold subsonic jet (2) the effects of jet temperature (3) the overall levels and spectral characteristics of shock associated noise and (4) excess noise possibly generated by a highly turbulent exit flow A R H

N79-23425# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

TRANSONIC FLOWS IN TURBOMACHINERY VOLUME 1 THEORY, PART 2

1973 182 p refs Lecture held at Rhode-Saint-Genese Belgium, 21-25 May 1973
(VKI-Lecture-Series-59-1-Pt-2) Avail NTIS HC A09/MF A01

The topics discussed include confluence of two supersonic jets at the trailing edge of transonic turbine blades shock boundary layer interaction in transonic and supersonic flow and shock boundary layer interaction in compressor cascades

N79-23426# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

THE CONFLUENCE OF TWO SUPERSONIC JETS AT THE TRAILING EDGE OF TRANSONIC TURBINE BLADES

C Sieverding *In its* Transonic Flows in Turbomachinery Vol 1 Theory Pt 2 1973 19 p refs

Avail NTIS HC A09/MF A01

Solutions to the problem of confluence in supersonic flow at the trailing edge of a blade are discussed and include development of shock patterns in transonic turbine cascades and base pressure and static pressure calculations S E S

N79-23428# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

SHOCK-BOUNDARY LAYER INTERACTION IN COMPRESSOR CASCADES A REVIEW OF AVAILABLE DATA

J Chauvin *In its* Transonic Flows in Turbomachinery Vol 1 Theory, Pt 2 1973 14 p refs

Avail NTIS HC A09/MF A01

The correlations of Fottner Starken and Griepentrog are reviewed and compared The different types of interactions are discussed SES

N79-23431*# National Aeronautics and Space Administration Pasadena Office Calif

CENTRIFUGAL-RECIPROCATING COMPRESSOR Patent Application

Walter H Higa inventor (to NASA) (JPL) Filed 8 May 1979 24 p Sponsored by NASA

(Contract NAS7-100)

(NASA-Case-NPO-14597-1 US-Patent-Appl-SN-037194) Avail NTIS HC A02/MF A01 CSCL 13I

A centrifugal compressor is presented which includes at least a pair of cylinders arranged in coaxial alignment and supported for angular displacement about a common axis of rotation normally bisecting a common longitudinal axis of symmetry for the cylinders The cylinders are characterized by ported closures located at the mutually rer ote ends thereof though which the cylinders are charged and discharged and a pair of piston heads seated within the cylinders and supported for floating displacement in compressive strokes in response to unidirectional angular displacement imparted to the cylinders NASA

N79-23450# Royal Netherlands Aircraft Factories Fokker Schiphol-Oost Technological Centre

OPERATIONAL EXPERIENCE WITH ADHESIVE BONDED STRUCTURES

Rob J Schliekelmann *In* AGARD Bonded Joints and Preparation for Bonding Mar 1979 30 p refs

Avail NTIS HC A14/MF A01

A survey is given of the operational experience with adhesive bonded structures in military and civil aircraft In view of the widely different qualifications of these experiences, from highly favourable' through 'very unfavourable' an introduction is given to the various problem areas that caused service troubles The objective is to develop full understanding of the principle causes of possible failures and to define ways and means to achieve fully reliable bonded joints that will play in the future an even more important role than today G Y

N79-23453# General Dynamics/Fort Worth Tex Materials Research Lab

BEHAVIOR OF ADHESIVELY BONDED JOINTS UNDER CYCLIC LOADING

John Romanko *In* AGARD Bonded Joints and Preparation for Bonding Mar 1979 42 p refs

Avail NTIS HC A14/MF A01

The state of the art in determining the fundamental mechanisms of fatigue degradation in structural adhesive joints and in identifying the dominant fatigue mechanisms with the service environmental regimes including cyclic mechanical loads temperature and humidity is presented The scope involves an in-depth assessment of fatigue mechanisms and failure modes primarily in adhesively bonded metal/metal joints over the range of loads and environmental conditions experienced by modern high performance aircraft Analytical and experimental stress analysis methods are described The joints are analyzed to describe the stress/strain distributions developed within the adhesive interlayer by load/environmental fatigue conditions Joint fatigue to various stages of joint life are examined for degradation mechanisms The development of methodology for predicting the necessary service life of adhesively bonded joints is outlined G Y

N79-23454# Douglas Aircraft Co Inc, Long Beach Calif

FAILURES IN ADHESIVELY BONDED STRUCTURES

Edward W Thrall Jr *In* AGARD Bonded Joints and Preparation for Bonding Mar 1979 89 p refs

(AF Proj 486U)

Avail NTIS HC A14/MF A01

The Primary Adhesively Bonded Structure Technology (PABST) program was undertaken to validate the bonded joint with tests and analyses The program structural tests conducted to compare the strength of bonded joints to the classical riveted design are presented The tests were conducted to determine allowables for static fatigue and damage tolerance (crack growth) Also presented are the analytical methods for predicting the bond line strength characteristics The analyses were found to match the test results G Y

N79-23455# Institut fuer Angewandte Materialforschung der Fraunhoffer-Gesellschaft e V, Bremen (West Germany)

THE NATURE OF ADHESION MECHANISMS AND THE INFLUENCE OF SURFACE TREATMENTS ON THE BEHAVIOUR OF BONDED JOINTS

Walter Brockmann *In* AGARD Bonded Joints and Preparation for Bonding Mar 1979 23 p refs

Avail NTIS HC A14/MF A01

The following topics are discussed (1) physical chemical and mechanical bonding mechanisms (2) surface treatment and bonding durability and (3) techniques for surface properties G Y

N79-23537# Association Aeronautique et Astronautique de France Paris

ADAPTATION FOR THE ECONOMY OR ADAPTATION FOR ENERGY CONSERVATION [ADAPTATION POUR L'ECONOMIE OU ADAPTION POUR L'ECONOMIE D'ENERGIE]

P Lecomte 1977 44 p refs In FRENCH Presented at the 13th Intern Aeron Congr, Paris, 2-3 Jun 1977

(AAAF-NT-77-23, ISBN-2-7170-0448-3) Avail NTIS HC A03/MF A01, CEDOCAR Paris FF 25 (France and EEC) FF 29 (others)

Text from an opening lecture at the Paris Aeronautical Internation Congress, June 1977 is presented The central argument is that optimization of aircraft design can not be based only on energy conservation, other factors being important Several graphs are given referring to various technical and economical situations The conclusions are that sound aircraft design must take into account factors or market competitivity and passenger's preferences and that some logical energy conserving ideas are, for instance modern turboprop for mach 0 6/0 7 short/medium distances straight wing jet for mach 0 75, innovation either in systems or structure, permitting weight reduction, and optimization of air traffic for minimal energy expenditure Author (ESA)

N79-23595# Air Force Geophysics Lab Hanscom AFB, Mass

A MODERN THERMO-KINETIC WARM FOG DISPERSAL SYSTEM Final Report

Bruce A Kunkel 14 Nov 1978 29 p refs

(AF Proj 2093)

(AD-A064428 AFGL-TR-78-0278 AFGL-AFSG-402) Avail NTIS HC A03/MF A01 CSCL 04/2

An extensive investigation has been made to arrive at optimum specifications for a thermo-kinetic warm fog dispersal system This study included passive heat tests sub-scale heat/momentum tests and tests with a single full-scale runway combustor and an approach zone combustor These tests were augmented with extensive analytical modeling of buoyant jets under coflowing and counterflowing wind conditions The landing category and the operational requirements within each category are the primary factors affecting the size of the thermal fog dispersal system (TFDS) A Cat 2 TFDS employs 22 percent fewer combustors and uses 50 percent less fuel than a Cat 1 TFDS The combustor specification and orientation are presented for both Cat 1 and Cat 2 systems Author (GRA)

N79-23804# Aeronautical Systems Div Wright-Patterson AFB Ohio

THUNDERSTORM TURBULENCE INVESTIGATIONS FOR 1973-1974 IN SUPPORT OF THE NATIONAL SEVERE STORMS LABORATORY (NSSL) Final Report, May - Jun 1973 and Apr - Jun 1974

Larry A Roberts Dec 1978 33 p

(AD-A065943 ASD-TR-78-1) Avail NTIS HC A03/MF A01 CSCL 04/2

During May and June of 1973 the 4950th Test Wing supplied an F-100F Thunderstorm Penetration aircraft to take turbulence measurements in support of a National Severe Storms Laboratory Program designed to evaluate Doppler radar as a means of detecting and quantifying turbulencd areas and intensities within severe storms The tests were flown out of Tinker AFB Oklahoma The program was continued the following year during the Oklahoma thunderstorm season April-June 1974 For the second year an RF-4C was used as a penetration aircraft This report presents the vertical wind and derived gust velocity experience accumulated during these two seasons and correlates them with statistical parameters radar reflectivity gradient of radar relectivity etc An attempt is made to determine if variations of the correlation coefficients relating these various quantities exhibits a trend as altitude is increased or decreased The results are not conclusive Author (GRA)

N79-23681# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering

A STUDY OF EMBEDDED COMPUTER SYSTEM SOFTWARE ACQUISITION MANAGEMENT AND RECOMMENDATIONS TO IMPROVE DEVELOPMENT VISIBILITY M S Thesis

Gary M Barbee Sep 1978 107 p refs

(AD-A065879, AFIT/GSM/SM/78S-1) Avail NTIS HC A06/MF A01 CSCL 09/2

The United States Air Force is the largest user of computers in the world and a major portion of that information processing capability is comprised of digital avionics computers This thesis describes some of the major problems of acquiring Embedded Computer System (ECS) software for avionics systems A description of the DOD avionics software acquisition process is included for background information as well as a discussion of the applicable guidance policies and regulations Recommendations to improve software acquisition were derived from literature research refined by interviews with practicing software engineers and managers and presented as a product of this thesis The interviews were conducted with software acquisition personnel at the Aeronautical Systems Division of Air Force Systems Command at Wright-Patterson AFB, Ohio A major conclusion of this thesis is that the development of a computer software management discipline is both necessary and feasible Author (GRA)

N79-23683# General Electric Co Daytona Beach Fla Space Div

SYSTEM DESCRIPTION AVIATION WIDE-ANGLE VISUAL SYSTEM (AWAVS) COMPUTER IMAGE GENERATOR (CIG) VISUAL SYSTEM Final Report

D V Morland Feb 1979 84 p refs

(Contract N61339-76-C-0048)

(AD-A065060 NAVTRAEQUIPC-76-C-0048-1) Avail NTIS HC A05/MF A01 CSCL 09/2

This report provides an overall description of the Aviation Wide Angle Visual System (AWAVS) Computer Image Generator (CIG) System installed at the Naval Training Equipment Center in Orlando Florida The report includes descriptions of system functions and capabilities system hardware and new technology features incorporated in the CIG System design Author (GRA)

N79-23754*# National Aeronautics and Space Administration Langley Research Center Hampton Va

PHYSICAL AND SUBJECTIVE STUDIES OF AIRCRAFT INTERIOR NOISE AND VIBRATION

David G Stephens and Jack D Leatherwood Apr 1979 16 p refs To be presented at Symp on Internal Noise in Helicopters Southampton England 17-20 Jul 1979

(NASA-TM-80084) Avail NTIS HC A02/MF A01 CSCL 20A

Measurements to define and quantify the interior noise and vibration stimuli of aircraft are reviewed as well as field and simulation studies to determine the subjective response to such stimuli and theoretical and experimental studies to predict and control the interior environment In addition ride quality criteria/standards for noise vibration and combinations of these stimuli are discussed in relation to the helicopter cabin environment Data on passenger response are presented to illustrate the effects of interior noise and vibration on speech intelligibility and comfort of crew and passengers The interactive effects of noise with multifrequency and multiaxis vibration are illustrated by data from LaRC ride quality simulator Constant comfort contours for various combinations of noise and vibration are presented and the incorporation of these results into a user-oriented model are discussed With respect to aircraft interior noise and vibration control ongoing studies to define the near-field noise the transmission of noise through the structure and the effectiveness of control treatments are described A R H

N79-23885# Office of Naval Research London (England)

EUROPEAN SCIENTIFIC NOTES, VOLUME 32, NUMBER 5

Aubrey W Pryce ed and Victoria S Hewitson ed May 1978 42 p

(AD-A065400 ESN-32-5) Avail NTIS HC A03/MF A01 CSCL 05/2

Contents Balloons Are Still Fashionable in France, More on Space from British Aerospace Company, Making Decisions on Nuclear Energy--British Ways Unintended Jamming Copper Alloys in the Marine Environment, Doing More with Less with Surface Coatings, Mehr Licht Mehr Licht -- Semiconductor Luminescence Research at Philips Physicits Tackle Organic Solids at the University of Stuttgart Stability Studies at the Universidad Autonoma de Madrid Fluid Mechanics at the Escuela Tecnica Superior de Ingenieros Industriales de Tarrasa Laser Sounding in the Stratosphere at Appleton Laboratory Human Factors and the Fighter Aircraft Cockpit of the 1990s and How Pilots Are Selected in West Germany GRA

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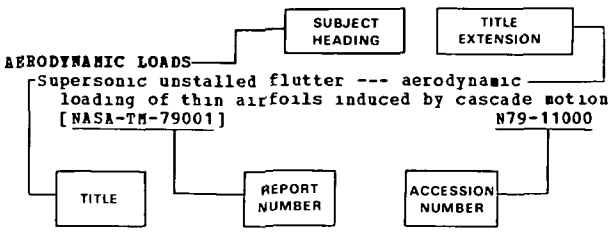

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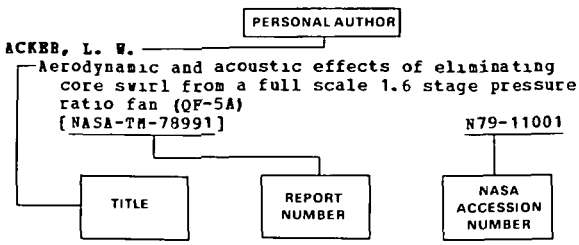

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