

NASA SP-7037 (60)



# AERONAUTICAL ENGINEERING

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A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 60

AUGUST 1975

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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Aeronautical Engineering

Pages 289-322

AUGUST 1975

# AERONAUTICAL ENGINEERING

## A Special Bibliography

### Supplement 60

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 1975 in

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



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# INTRODUCTION

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

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 284 reports, journal articles, and other documents originally announced in July 1975 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

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

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

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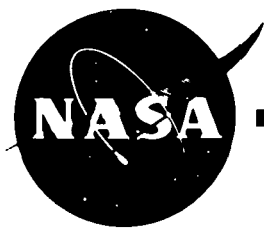
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## TYPICAL CITATION AND ABSTRACT FROM STAR

NASA SPONSORED DOCUMENT		AVAILABLE ON MICROFICHE
ACCESSION NUMBER	N75-10005*# Lockheed-Georgia Co., Marietta	CORPORATE SOURCE
TITLE	GROUND EFFECT FOR V/STOL AIRCRAFT CONFIGURATIONS AND ITS SIMULATION IN THE WIND TUNNEL. PART 3 THE TANGENTIALLY BLOWN GROUND AS AN ALTERNATIVE TO A MOVING GROUND APPLICATION TO THE NASA-AMES 40 BY 80-FOOT WIND TUNNEL	PUBLICATION DATE
AUTHOR	J E Hackett, E B Praytor, and E O Caldwell [1973] 59 p refs	AVAILABILITY SOURCE
CONTRACT OR GRANT	(Contract NAS2-6690) (NASA-CR-114497) Avail NTIS HC \$4 25 CSCL 01B	COSATI CODE
REPORT NUMBER	<p>A set of conceptual drawings showing the application of slot-blowing boundary layer control to the 40- by 80-foot wind tunnel is presented. In small scale pilot experiments unswept slots were used, fed by a below-floor plenum. The model was sting mounted and its wing was unswept. However design for the Ames tunnel was heavily constrained, both by under floor balance mechanisms and by a large turntable. An over floor supply system was therefore designed. A description of appropriate procedures for using the floor tangential blowing system is given. Though some of the operating graphs are specific to the design for the Ames tunnel, both non-dimensional plots and the approach generally are widely applicable.</p> <p style="text-align: right;">Author</p>	

## TYPICAL CITATION AND ABSTRACT FROM IAA

NASA SPONSORED DOCUMENT		AVAILABLE ON MICROFICHE
ACCESSION NUMBER	A75-10336*#	TITLE
AUTHORS	L. P Ludwig and R L Johnson (NASA, Lewis Research Center, Cleveland, Ohio) <i>American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1188</i> 12 p 23 refs	AUTHORS' AFFILIATION
	<p>Experimental evaluation under simulated engine conditions revealed that conventional mainshaft seals have disadvantages of high gas leakage rates and wear. An advanced seal concept, the self-acting face seal, has a much lower gas leakage rate and greater pressure and speed capability. In endurance tests (150 hr) to 43,200 rpm the self-acting seal wear was not measurable, indicating that noncontact sealing operation was maintained even at this high rotative speed. A review of published data revealed that the leakage through gas path seals has a significant effect on thrust specific fuel consumption, stall margin, and engine maintenance. Reducing leakages by reducing seal clearances results in rubbing contact, and then the seal thermal response and wear determines the final seal clearances.</p> <p style="text-align: right;">(Author)</p>	TITLE OF PERIODICAL
		PUBLICATION DATE



# AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 60)

AUGUST 1975

## IAA ENTRIES

**A75-29197 #** Low Reynolds number effect on hypersonic lifting body turbulent boundary layers J C Adams, Jr (ARO, Inc., von Karman Gas Dynamics Facility, Arnold Air Force Station, Tenn) *Journal of Spacecraft and Rockets*, vol 12, Feb 1975, p 126-128 15 refs

**A75-29261** The zone navigation system of the DC-10 (Le système de navigation de zone du DC-10). C Gouillon (Union de Transports Aériens, Paris, France) *Navigation* (Paris), vol 23, Apr 1975, p 160-171 In French

Four European airlines have joined together in an effort to ease overcrowding of aircraft routes by providing the craft with accurate, ground radio-independent means of navigation. The objectives of this system are (1) to improve safety by eliminating the human error factor, (2) to reduce work load by automating navigation between takeoff and landing, and (3) to reduce flight costs by a better use of air space  
S J M

**A75-29262** Problems and perspectives of navigation over large distances (Problèmes et perspectives de navigation à longue distance) S H Doddington (International Telephone and Telegraph Co., New York, N Y) *Navigation* (Paris), vol 23, Apr 1975, p 173-182 30 refs In French

Current systems of short-range and large-distance navigation are examined, and reasons for the more advanced evolution of the former are given. It is emphasized that significant improvement will be required in the latter realm. Proposed long-range navigation systems investigated include the transit system, the airborne Doppler navigator, the inertial system, Loran-A, Loran-C, Omega, and the universal system of satellite positioning  
(Author)

**A75-29344 #** Application of a numerical process to the optimization of helicopter design (Zastosowanie numerycznego procesu optymalizacji w projektowaniu śmigłowców). K Szumanski *Instytut Lotnictwa, Prace*, no 60, 1974, p 3-24 10 refs In Polish

Possible means of developing an effective numerical method for qualitative evaluation of helicopter designs are discussed. The use of technical criteria and of quantitative indices describing helicopter characteristics for this purpose is considered. An attempt is made to evaluate the quality of helicopter design by a multiparameter optimization process. The range of optimization is limited to the selection of the helicopter system and the determination of the design parameters for the system chosen  
V P

**A75-29345 #** Laminated wood for propeller blades (Drewno warstwowe lotnicze jako materiał do wyrobu drewnianych łopatek śmigłowców). Z Krukowski *Instytut Lotnictwa, Prace*, no 60, 1974, p 25-37 9 refs. In Polish

The causes of cracks of glued joint laminated in semi-finished wood propeller blades were the subject of the investigation reported. It was found that these defects are caused by the hygroscopic properties of laminated wood and it was attempted to produce a material more resistant against cracking. A cresol resin was used which enabled the production, within the frames of laboratory tests, of a material showing considerably smaller deformation and limited liability to cracking  
(Author)

**A75-29348 #** Window-pane design and strength problems for modern aircraft (Problemy konstrukcyjno-wytrzymałościowe szyb współczesnych samolotów) J Borzyszkowski *Instytut Lotnictwa, Prace*, no 60, 1974, p 75-90 12 refs In Polish

The basic structural requirements placed on window panes of pressurized aircraft fuselages and methods of testing aircraft window panes are reviewed. It is shown that these testing methods are not always applicable to small pressurized trainer aircraft whose window panes are fastened at the edges. A simplified method for testing window panes of this type is proposed  
V P

**A75-29349 #** The influence of the spacing of dynamically non-identical axial compressor blades on the magnitude of the stress (Napężenia w niejednakowych łopatkach stopnia sprężarki osiowej) E Stankiewicz *Instytut Lotnictwa, Prace*, no 60, 1974, p 91-106 5 refs In Polish

The equations of motion are derived for mechanically coupled blades of an axial compressor stage. Making use of a generalized form of the solution expressing the stress amplitudes of identical blades in steady forced vibration, further relations are derived enabling the determination of the stress increase due to a deviation of blade rigidity for any spacing of the blades. Finally the problem of most advantageous spacing of non-identical blades is discussed  
(Author)

**A75-29394** Aerodynamic damping of turbine blade oscillations in air flow A A Kammer and N Ia Nastenka (Akademia Nauk Ukrainy SSR, Instytut Problem Prochnosti, Kiev, Ukrainian SSR) (*Problemy Prochnosti*, vol 6, June 1974, p 55-57) *Strength of Materials*, vol 6, no 6, Mar 1975, p 709-712 6 refs Translation

Experimental measurement of the aerodynamic damping force exerted on turbine blades experiencing plane-parallel vibration in a wind tunnel. The test blades were mounted on a vibration isolating suspension, and an electromagnetic exciter was used to excite blade vibration in the ambient flow. The exciter was turned off at a given instant, and the aerodynamic damping force was determined as the difference between overall damping in the presence of flow and the mechanical damping in the absence of flow. Graphs for two different types of blades illustrate the dependence of aerodynamic damping on a mass criterion and the Strouhal number  
T M

**A75-29436 #** Computation of the flow of a rarefied gas around a cylinder (Raschet obtekanii tsilindra razrezhennym gazom). E F Limar *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki*, vol 15, Jan-Feb 1975, p 266-269 9 refs In Russian

Examination of the steady flow of a supersonic rarefied gas, directed perpendicular to the cylinder axis, around an infinitely long circular cylinder. The two-dimensional flow problem is solved for a model kinetic equation proposed by Bhatnagar, Gross, and Krook (1954). The results are compared to experimental data and the results of numerical computations  
A T S

**A75-29462 \* # Separated flow over a body of revolution** F J Marshall (Purdue University, West Lafayette, Ind.) and F D Deffenbaugh *Journal of Aircraft*, vol 12, Feb 1975, p 78-85 31 refs Grant No NGR-15-005-119

A method is developed to determine the flowfield of a body of revolution in separated flow. The technique employed is the use of the computer to integrate various solutions and solution properties of the sub-flowfields which make up the entire flowfield without resorting to a finite difference solution to the complete Navier-Stokes equations. The technique entails the use of the unsteady cross flow analogy and a new solution to the required two-dimensional unsteady separated flow problem based upon an unsteady discrete-vorticity wake. Data for the forces and moments on bodies of revolution at high angle of attack (outside the range of linear inviscid theories) such that the flow is substantially separated are produced which compare well with experimental data at low speeds. In addition, three-dimensional steady separation regions and wake vortex patterns are determined. (Author)

**A75-29463 # Generalized integrated square error criterion for optimal and suboptimal control design.** T Miski (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugführung, Braunschweig, West Germany) *Journal of Aircraft*, vol 12, Feb 1975, p 105-109 12 refs

By showing the equivalence of quadratic cost functionals to the classical generalized integrated square error (GISE) performance index, a simple optimal control design procedure for linear time-invariant single input systems is presented. The eigenvalues of the optimal system can be directly determined from the weighting factors of the GISE. The method closely relates the inverse problem of optimal control theory and gives a new, straightforward solution. It is also shown that the GISE represents a criterion of least-square approximation which can be used to solve the model following problem and to establish a suboptimal control as well. The parameters of a suboptimal control law can be determined by minimizing the GISE. For this purpose, a new simple method of evaluating the GISE is given. The technique is illustrated by designing an aircraft altitude control system. (Author)

**A75-29464 \* # Iterative techniques for the solution of large linear systems in computational aerodynamics.** A Bratkovich and F J Marshall (Purdue University, West Lafayette, Ind.) *Journal of Aircraft*, vol 12, Feb 1975, p 116-118 7 refs Grant No NGR-15-005-188

**A75-29465 # Prediction of airfoil tone frequencies.** M R Fink *Journal of Aircraft*, vol 12, Feb 1975, p 118-120 10 refs

Recent experiments on the prediction of airfoil tone frequencies are compared with boundary layer theory. It is concluded that measured tone frequencies for airfoils radiating vortex shedding noise (airfoil wake-generated noise) can be predicted directly from that theory without the use of empirical constants. Such noise can be eliminated by tripping the laminar boundary layer at model scale or by increasing the Reynolds number toward full scale. S J M

**A75-29466 # Pressure field of a vortex wake in ground effect.** C E Brown (Hydronautics, Inc., Laurel, Md.) *Journal of Aircraft*, vol 12, Feb 1975, p 120, 121 USAF-supported research

The distribution of ground pressure under a symmetrical descending vortex pair is theoretically derived. As the vortices first approach the ground, only positive pressures are produced, however, as the descent continues, the high velocity field of the vortices becomes apparent in the dips to subatmospheric pressure which lie closely beneath the vortex center. The level of pressures produced is dependent only on flight speed, lift coefficient and aspect ratio, but

the length scale of the pressure distribution is proportional to wing span. S J M

**A75-29467 # Effect of heating on leading edge vortices in subsonic flow.** J F Marchman, III (Virginia Polytechnic Institute and State University, Blacksburg, Va.) *Journal of Aircraft*, vol 12, Feb 1975, p 121-123

Results are presented from an experimental study of the effect of re-entry heating on the high-lift leading edge vortices of a delta wing. It is found that wing surface to freestream temperature ratio has virtually no effect on either lift or pitching moment, but that it has a strong positive influence on drag. Therefore, heating has no apparent effect on leading edge vortices. S J M

**A75-29469 # Approximate solution of minimum induced drag of wings with given structural weight.** A Klein (Motoren- und Turbinen-Union München GmbH, Munich, West Germany) and S P Viswanathan (Bell Helicopter Co., Fort Worth, Tex.) *Journal of Aircraft*, vol 12, Feb 1975, p 124-126

A solution is derived to the optimization of spanwise loading to provide minimum induced drag. It is based on the common practice of determining the structural weight of wings in steady flight by the integrals of the spanwise shear-force and bending-moment distributions. An equation is derived expressing a circulation-distribution that gives 7% less induced drag than elliptical loading, provided structural weight and lift remain constant. S J M

**A75-29470 # Comment on 'Exact method of designing airfoils with given velocity distribution in incompressible flow'.** R. H. Liebeck (Douglas Aircraft Co., Long Beach, Calif.) *Journal of Aircraft*, vol 12, Feb 1975, p 127, Reply, p 127, 128 10 refs

**A75-29490 # Radiation conductivity and coupling of magnetic dipoles surrounded by a spherical dielectric sheath (Provodimost' izlucheniia i vzaimnaia sviaz' magnitnykh vibratorov, okruzhennykh sfericheskimi dielektricheskimi sloem).** R P Starovoirova and V B Kopach *Radioelektronika*, vol 18, Feb 1975, p 83-85 In Russian

The present paper reports the results of theoretical studies which have application to the design of aircraft antennas. An ideal magnetic dipole inside a spherical dielectric shell was used as an equivalent model in order to investigate the effect of a hemispherical dielectric fairing on the radiation conductivity and the coupling of elementary slot radiators cut in an infinite, flat, ideally conducting screen. The dielectric shell is found to have identical effects on the radiation conductivity of half-wave and Hertzian dipoles located at the center of the shell. A T S

**A75-29608 # Problems of preflight maintenance (Problemy obsluzhivaniia startovoi)** A Olesinski and A Slodownik *Technika Lotnicza i Astronautyczna*, vol 29, Mar 1975, p 10-12 In Polish

The various factors involved in the process of making a passenger aircraft ready for takeoff are reviewed and systematized. The influence of the type of aircraft on the maintenance procedure is illustrated, with particular reference to economic efficiency. V P

**A75-29609 # Analysis of the interaction between the turbine engine and the rotor of a helicopter (Analiza wspolpracy silnika turbinowego z wirnikiem nosnym smiglowca)** T Gajewski (Wyższa Oficerska Szkoła Lotnicza, Dęblin, Poland) *Technika Lotnicza i Astronautyczna*, vol 29, Mar 1975, p 12-16 In Polish

The theory of the interaction between a helicopter rotor and turbine engine is outlined, and the influence of the interaction on the helicopter operational and design parameters is examined. The use of a variable rotational speed as a means of controlling the joint operation of the engine-rotor system is discussed for the case of a double-shaft engine. V P

**A75-29610 #** Determination of the lifetime of acoustically loaded aircraft structures (Okreslanie żywotności struktury samolotu obciążonej akustycznie). *Tekhnika Lotnicza i Astronautyczna*, vol. 29, Mar. 1975, p. 23-26. 5 refs. In Polish.

Some general aspects of acoustic loads are discussed, and the need of taking acoustic loads into consideration in the preliminary design of aircraft structures is pointed out. Methods of determining the structural fatigue of aircraft under acoustic loads are described, with particular reference to an empirical method which uses only 28% of the acoustic power required in the traditional simulation of wide-band noise spectra for reproducing the test loads. V.P.

**A75-29611 #** Improving the structural fatigue characteristics of aircraft by using bonded sandwich structures I (Ulepszenie własności zmęczeniowych konstrukcji samolotu dzięki zastosowaniu struktur warstwowych klejonych. I). R. Switkiewicz (Warszawa, Politechnika, Warsaw, Poland). *Tekhnika Lotnicza i Astronautyczna*, vol. 29, Mar. 1975, p. 27, 28. In Polish.

Possible approaches to the problem of improving aircraft structural fatigue life are discussed, and methods based on the use of cracked samples are described. The superiority of the fatigue characteristic of bonded sandwich panels over those of sheet material is demonstrated experimentally. The properties of sandwich panels bonded with different adhesives are examined. V.P.

**A75-29725** Development of a silicone-base fire-resistant hydraulic fluid for use in military aircraft. A. A. Conte, Jr., L. Stallings, E. R. Lamson, and M. J. Devine (US Naval Material Command, Naval Air Development Center, Warminster, Pa.) (*American Society of Lubrication Engineers, Annual Meeting, 29th, Cleveland, Ohio, Apr. 28-May 2, 1974*). *Lubrication Engineering*, vol. 31, Apr. 1975, p. 195-200. Navy-sponsored research.

This paper reports on the laboratory development of a fire-resistant aircraft hydraulic fluid for military applications. A chlorophenylmethylsilicone fluid incorporating unique antiwear and rubber swell additives has been found to exhibit many of the desirable properties of a good hydraulic fluid in addition to possessing superior fire resistance. This fluid was formulated to maintain its antiwear properties when mixed in all proportions with the presently used extremely flammable petroleum-base hydraulic fluid (MIL-H-5606C) and to prevent shrinkage of currently used Buna N elastomer seals. Because of these properties, this fluid is considered as a prime candidate for replacing MIL-H-5606 in military aircraft without requiring a costly retrofit procedure. In developing this fluid, certain 'trade-offs' had to be considered in order to obtain a formulation with enhanced fire-resistance properties. It is considered that these differences will not pose undue restrictions on its widespread use in military aircraft hydraulic systems operating at temperatures as high as 275 F. (Author)

**A75-29762 #** Import substitution of rigid cellular plastics for aerospace industry. K. Nair (Hindusthan Aeronautics, Ltd., Bangalore, India). *Institution of Engineers (India), Journal, Mechanical Engineering Division*, vol. 55, Nov. 1974, p. 56-59. Discussion, p. 59.

Rigid plastic foams are used in the construction of lightweight stiff structures in aerospace vehicles. Foams of different densities were prepared in collaboration with a private industry. These were evaluated in comparison with imported foams to assess their suitability for aerospace applications. Results of tests indicated that the indigenously made foams can be used in place of the imported material. (Author)

**A75-29763 #** Partial admission losses in an axial flow reaction turbine. S. M. Yahya and D. P. Agrawal (Indian Institute of Technology, Delhi, India). *Institution of Engineers (India), Journal, Mechanical Engineering Division*, vol. 55, Nov. 1974, p. 60-63. 13 refs.

For estimating losses in an axial-flow reaction turbine, experiments were conducted at 100%, 74%, 50%, 40%, 26%, and 16%

degree of admission. Losses were found to increase with decreasing degree of admission at a given Reynolds number. Losses also increased with decreasing Reynolds number, as expected. The plot of rotor exit velocity and angle against length of rotor periphery shows that flow in a partial admission turbine is asymmetric. Also, losses in reaction turbine employing partial admission are higher than those occurring in an impulse turbine. (Author)

**A75-29801 #** Experimental study of the effect of large blade elongations on the aerodynamic characteristics of axial-compressor stages (Opytnoe issledovanie vlianiia bol'shikh udlinenii lopatok na aerodinamicheskie kharakteristiki stupeni osovogo kompressora). A. N. Anutin, V. N. Ershov, V. I. Komlev, V. Iu. Nezymb, and V. A. Faminskii. *Aviatsionnaia Tekhnika*, vol. 18, no. 1, 1975, p. 5-9. 6 refs. In Russian.

**A75-29802 #** Determination of unsteady temperature fields in the turbine disk of a short-acting turbopump unit (Opređenje nestatsionarnykh temperaturnykh polei v turbinnom diske TNA kratkovremennogo deistviia). A. A. Afanas'ev and F. P. Zakharchenko. *Aviatsionnaia Tekhnika*, vol. 18, no. 1, 1975, p. 10-13. In Russian.

A method proposed by Sekistov and Fomichev (1970) for calculating temperature fields and thermal stresses is applied to the calculation (on a digital computer) of the unsteady temperature fields in a turbine disk, assuming that the turbopump operates in a mode characterized by a constant gas temperature, constant rpm's, etc. It is shown that during the first 30 sec of operation, the thermal gradient between the rim and the hub of the disk increases first to 500 or 600 C and decreases then to 300 or 400 C. The rim of the disk is heated nonuniformly in the radial direction during the first moments of operation, and the temperature is distributed nonlinearly over the disk radius. V.P.

**A75-29804 #** Optimization of the air cooling systems of aircraft gas-turbine blades. II - Thermodynamic analysis (K optimizatsii sistem vozdushnogo okhlazhdeniia lopatok aviatsionnykh gazovykh turbin. II - Termodinamicheskii analiz). E. N. Bogomolov. *Aviatsionnaia Tekhnika*, vol. 18, no. 1, 1975, p. 18-25. 5 refs. In Russian.

An exergonic method of analysis is proposed for internal blade cooling systems. Performance criteria are derived for the air supply system and for the air-cooled blade itself. A method of optimizing the parameters of the air-supply system is described, along with a method of designing blades for maximum cooling depth. V.P.

**A75-29811 #** Heat and mass transfer in the flow of a high-enthalpy gas in the air-gas flow area of aircraft and rocket engines (Teplomassoobmen pri techenii vysokoental'p'nogo gaza v protochnykh chastiakh aviatsionnykh i raketnykh dvigatelei). A. V. Fafurin, Iu. D. Krechetnikov, A. Ia. Semichev, and N. A. Nadyrov. *Aviatsionnaia Tekhnika*, vol. 18, no. 1, 1975, p. 54-60. 16 refs. In Russian.

The rate of burnup of the heat protective coating of an aircraft engine's air-gas flow area is studied analytically. A solution is obtained by integrating boundary layer equations in which unsteady-state effects caused by chemical erosion of the flow-area surface are taken into account. V.P.

**A75-29812 #** Analysis of the characteristics of a ducted-fan engine with a small-size gas-turbine engine in the outer duct (Analiz kharakteristik dvukhkонтурnykh turboreaktivnykh dvigatelei s malorazmernymi GTD v naruzhnom konture). B. D. Fishbein. *Aviatsionnaia Tekhnika*, vol. 18, no. 1, 1975, p. 61-69. 9 refs. In Russian.

The results of a thermodynamic analysis of the thrust and fuel-consumption characteristics of a ducted-fan engine containing a gas-turbine in the outer duct are examined and are compared with those of a turbojet engine with an afterburner. A means of reducing the specific fuel consumption during takeoff, acceleration, and supersonic flight conditions is proposed for the configuration employing a gas turbine. V.P.

**A75-29813 # Stability of pressure regulators for aircraft hydraulic systems (Ob ustoychivosti regulatorov davleniya aviatsonnykh gidrosistem).** V V Berdnikov and L Ia Mironiuk *Aviatsonnaia Tekhnika*, vol 18, no 1, 1975, p 70-72 In Russian

A stability analysis is carried out for a direct-acting pressure regulator with a positive-displacement variable-stroke pump. The stability regions of the regulator are obtained in generalized coordinates. The results are applicable to the synthesis and analysis of pressure regulators of various type. V P

**A75-29814 # Calculation of the flow field at an air intake, operating in place, by the source-sink method /two-dimensional case/ (Raschet polia techeniya okolo vozdukhozabornika, rabotaiushchego na meste, metodom raspredelennykh stokov-istochnikov /ploskii sluchai/).** K V Vafin, L N Bortnikov, V A Prusova, and A M Shapiro *Aviatsonnaia Tekhnika*, vol 18, no 1, 1975, p 72-76 5 refs In Russian

The calculations of the flow field are carried out for an ideal potential flow, assuming that the sinks and sources are distributed in the plane of the inlet and in an imaginary plane, respectively. A model for calculating air intakes without inner body is proposed which can be readily extended to air intakes of more complex configuration and to the three-dimensional case. It is shown that allowance for finite dimensions of the air intake leads to a substantial increase in local velocities at the casing, as compared to an air intake simulated by a point sink. V P

**A75-29818 # Investigation of an annular gas-turbine nozzle grid with auxiliary blades in the interblade channels (Issledovanie kol'tsevoi soplovoi reshetki gazovoi turbiny s dopolnitel'nymi lopatkami v mezhlopatochnykh kanalakh).** B A Tikhomirov and V P Bashurov *Aviatsonnaia Tekhnika*, vol 18, no 1, 1975, p 91-95 In Russian

**A75-29872 The fixed shaft constant speed variable torque turbine /Sir Henry Royce Memorial Lecture/** J Szydlowski (Turbo-meca, S A, Bordes, Pyrénées-Atlantiques, France) *Aeronautical Journal*, vol 79, Mar 1975, p 105-113

Safety, economy, and simplicity advantages of the single-shaft over the multi-shaft turbine are outlined. It is concluded that the abandonment of the former in favor of the latter was a costly technical error, especially as regards fuel economy. Safety characteristics are reviewed for helicopters, propulsion, and bypass engines, and simplicity concerning calculations and development is discussed. S J M

**A75-29874 Aspect of non-destructive inspection in relation to service failure analysis** E A B de Graaf (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands) *Aeronautical Journal*, vol 79, Mar 1975, p 122-133 5 refs

The present paper deals with a number of aircraft component service failures. First, it discusses how inspection procedures can be improved as a consequence of service failure analysis; second, it considers the possibility that changes in existing inspection procedures may lead to unexpected defect discoveries; third, it shows that the use of standard nondestructive techniques in unusual ways can result in increased effectiveness; and last, it demonstrates that the application of inspection techniques employing fluids can influence the subsequent analysis of a failure. S J M

**A75-29899 Airships - The future** E Mowforth *CME - Chartered Mechanical Engineer*, vol 22, Apr 1975, p 66-71

The present article derives causes for past failures and criteria for the future viability of the airship. A rundown on the range of proposals now being studied by various groups is given. The potential of hybrids to entertain the serious consideration of engineers is emphasized, and the low cost and large size requirements on future designs are pointed out. S J M

**A75-29900 High reliability servo systems.** G N. Beaven (National Gas Turbine Establishment, London, England) and R. J Osborne (Ministry of Defence /Procurement Executive/, Directorate of Aircraft Mechanical and Electrical Engineering Equipment R & D, London, England) *CME - Chartered Mechanical Engineer*, vol 22, Apr 1975, p 81-85

The use of engine test cells to evaluate the performance of electrohydraulic servo systems is described. Development-phase engine testing, cell design philosophy, engineering redundancy, the cell installation itself, operation of failure monitoring systems, and future developments in the field of ETF (engine test facilities) are discussed. It is shown that the triplex majority vote form of redundancy can be implemented effectively in a simple direct way from standard, commercially available components which, for certain applications, can provide a high degree of reliability. S J M.

**A75-29910 New forging process promises - Lower cost titanium parts.** K M Kulkarni (IIT Research Institute, Chicago, Ill) *Machine Design*, vol 47, May 1, 1975, p 86-88

Isothermal forging of titanium alloys is assessed. The difficulties encountered in conventional forging are reviewed, and the isothermal forging process is described, in which the titanium preform and the dies are essentially at the same temperature and heat loss from the preform during forging is minimized. Requirements for a suitable die material, the best die material (IN-100 nickel-base superalloy), and the best die fabrication and heating methods are described; lubrication of dies and surface protection of forging blanks are outlined, and the metallurgical quality and mechanical properties of isothermal forgings are shown to be excellent. The cost effectiveness of such forgings is considered. F G M

**A75-29953 Thermal deformation vector for a bilinear temperature distribution in an anisotropic quadrilateral membrane element.** D V Wallerstein (Lockheed-California Co., Burbank, Calif) *International Journal for Numerical Methods in Engineering*, vol 9, no 2, 1975, p 325-336 7 refs

This paper presents a thermal-structural deformation vector for an anisotropic quadrilateral membrane element. The elastic properties of the element are based on linear stress assumptions and were developed by Robinson. A general bilinear temperature field within the element is chosen in order to obtain a thermal deformation capability for the element commensurate with its elastic capability. A pseudo shear term is developed to account for part of the thermal deformation. The element is suitable for finite element analysis of advanced aircraft structures under elevated temperature environments and is particularly well suited for analysis of regions with severe temperature gradients such as occur in the vicinity of local heat sources and sinks. An example problem is included to demonstrate the behaviour of the element. (Author)

**A75-29956 Mathematical programming in wing theory** R K Bera (National Aeronautical Laboratory, Bangalore, India) *International Journal for Numerical Methods in Engineering*, vol 9, no 2, 1975, p 401-413 12 refs

It is shown that mathematical programming (MP) finds useful application in wing theory. This is illustrated by posing wing theoretical problems as programming problems within the framework of the linearized lifting surface theory. A great merit of programming techniques is their ability to accommodate inequality constraints in a problem. This feature allows a wing theoretician to expand into a domain of practical problems where qualitative constraints can be included into his formulations. A few numerical examples involving the Prandtl lifting line equation with equality and inequality constraints are given to show that the method works. Its extension to complex wing-body problems poses no conceptual difficulties, but requires further numerical experimentation. (Author)

**A75-30059 # Study of supersonic flow around a slender elliptical cone with an angle of attack (Issledovanie sverkhzvukovogo obtekaniiya ostrogo ellipticheskogo konusa pod uglom ataki)** V N

Vetlutskiĭ and V. L. Ganimedov *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, Jan.-Feb. 1975, p. 114-120 18 refs. In Russian

Numerical solution of gasdynamic equations is used to determine the supersonic flow pattern of an ideal gas around a slender elliptical cone. The entire flow region is calculated for small angles of attack. For large angles of attack, a solution is obtained in a region which is bounded by a three-dimensional surface. A study is made of the dependence of the flow parameters on the angle of attack when the shock wave is attached to the apex of the cone. A T S

**A75-30060 #** Influence of the compressibility of the gas on the stability of the subsonic boundary layer on a permeable surface (Vliianie szhimaemosti gaza na ustoychivost' pogranichnogo sloia nad promtsaemoi poverkhnost'yu pri dozvukovykh skorostiakh) S. A. Gaponov *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, Jan.-Feb. 1975, p. 121-125 8 refs. In Russian

**A75-30118 #** Some results of research on transpiration cooling of gas-turbine blades (Nekotorye rezul'taty issledovaniĭ poristogo okhlazhdeniia lopatok gazovyykh turbin) V. M. Epifanov and E. A. Manushin (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR) *Inzhenerno-Fizicheskii Zhurnal*, vol. 28, Mar. 1975, p. 533-544 16 refs. In Russian

Transpiration cooling is a method by which air is pumped through a branched network of microchannels (pores) to the outer surface of the porous profile envelope of a turbine blade, thus producing an insulating film. The method has been studied since the early 1940s, and its applicability in turbojet engines was recognized by 1946. The present paper reviews the history of research on transpiration cooling in turbines, with particular attention to the development of the J-65 engine. Materials research has shown that there are no fundamental problems, besides the oxidation problem, in producing transpiration-cooled turbine blades. The results of research on the heat-exchange properties and the aerodynamic characteristics of transpiration-cooled blades are discussed. Heat exchange outside the porous envelope, within it, and in the internal channels is covered. A T S

**A75-30137 #** Vibration of non-uniform thin-walled beams of arbitrary shape. S. Suryanarayan (Indian Institute of Technology, Bombay, India) and A. V. Krishna Murty (Indian Institute of Science, Bangalore, India) *Zeitschrift für angewandte Mathematik und Mechanik*, vol. 55, Mar. 1975, p. 159-169 7 refs. Research supported by the Ministry of Defence of India

A generalized theory for the natural vibration of non-uniform thin-walled beams of arbitrary cross-sectional geometry is proposed. The governing equations are obtained as four partial, linear integro-differential equations. The corresponding boundary conditions are also obtained in an integro-differential form. The formulation takes into account the effect of longitudinal inertia and shear flexibility. A method of solution is presented. Some numerical illustrations and an exact solution are included. (Author)

**A75-30228 #** Quantitative estimates of the indeterminacy of motion (O kolichestvennykh otsenkakh neopredelennosti dvizheniia). Iu. M. L. Kostjukovskii and A. I. Nefelov *Prikladnaia Matematika i Mekhanika*, vol. 39, Jan.-Feb. 1975, p. 30-35. In Russian.

The present work proposes some quantitative estimates of the indeterminacy involved in the prediction of the motion of a controlled system described by ordinary differential equations. The example of the motion of an aircraft in a nominal rectilinear horizontal flight and stabilized at a constant altitude by the necessary elevator deviations is examined. P T H

**A75-30266** High-speed gas flow with heat exchange (Ecoulement des gaz à grande vitesse avec échange de chaleur). R. Marques and J. Falvene (Barcelona, Universidad, Barcelona, Spain) *Entropie*, vol. 10, no. 60, 1974, p. 4-8 14 refs. In French

The authors present a study of gas flow through a constant-section duct, with heat exchange between the wall and the fluid, taking friction into account. On applying the basic laws of mechanics and thermodynamics of fluids, equations are derived which give an account of changes in pressure, temperature and Mach number along the duct. The flow problem under consideration covers, as particular cases, Rayleigh and Fanno flows. (Author)

**A75-30298 #** Acoustic shielding at the aircraft by means of a suitable engine position (Schallabschirmung am Flugzeug durch geeignete Triebwerksposition) B.-H. Grunewald (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 7th, Kiel, West Germany, Sept. 17-19, 1974, Paper 74-114* 18 p. 5 refs. In German

Fundamental theoretical relations which provide the basis for the calculation of the acoustic shielding effects of walls are considered. A description is given of acoustic measurements which were conducted to determine the effect of engine location on acoustic shielding. A 1/5 model of the VFW 614 was used in the investigations. Loud speakers were employed as acoustic sources. The sound intensity was determined with the aid of microphones. Attention is given to the relative significance of shielding and reflection effects. G R

**A75-30299 #** Theoretical investigations for reducing fan noise (Theoretische Untersuchungen zur Minderung des Gebläselarms). K. Heinig and P. Schulz (Motoren- und Turbinen-Union München GmbH, Munich, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 7th, Kiel, West Germany, Sept. 17-19, 1974, Paper 74-115* 31 p. 19 refs. In German

The characteristics of the various fan noise components are examined, giving attention to the individual noise sources. A description is given of an analytical computational procedure which takes into account the principal causes of noise generation. The suitability of the described approach for noise calculations in practical applications is demonstrated by comparing measured and computed data. Applications of the analytical procedure in parametric studies of approaches for reducing fan noise are discussed. G R

**A75-30300 #** Air breathing engines in the Federal Republic of Germany (Luftatmende Antriebe in der Bundesrepublik Deutschland). E. Riestler and E. Schnell *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 7th, Kiel, West Germany, Sept. 17-19, 1974, Paper 74-72* 30 p. In German

An investigation was conducted concerning the specific areas in the field of air breathing engines in which more research and development work is needed. Studies of engine acoustics were felt to be particularly urgent. International cooperation is to be encouraged. However, it is considered important that national technological capacities be maintained. G R

**A75-30384** Investigation into behavior of plates and shells on the basis of the integrodifferential equations of nonstationary aeroelasticity. S. M. Belotserkovskii, A. S. Vol'mir, and A. T. Ponomarev (*Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela*, vol. 9, no. 6, 1974, p. 85-94) *Mechanics of Solids*, vol. 9, no. 6, 1974, p. 75-82 5 refs. Translation

A method is proposed that makes it possible to solve complex problems in the aeroelasticity of plates and shells. It consists in decomposition of system motion into certain specified forms. By separating the aerodynamic from the elastic portions of the problem, it reduces the volume of machine computation considerably. The method is applied to the example of the skin of a wing; this problem is of considerable interest, since the elastic system has in this case fairly high natural frequencies, while the periods of the natural oscillations are comparable to the time required for disturbances to propagate in a gas. S J M

**A75-30409 #** Dependence of the fatigue and fatigue-corrosion life of V95 alloy on the anodizing temperature and the anode film thickness (Zavisimost' ustalostnoi i korrozionno-ustalostnoi dolgovechnosti splava V95 ot temperatury anodirovaniia i tolshchiny anodnoi plenki). A V Karlashov, R G Gainutdinov, and A V Golubnichii (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR) *Fiziko-Khimicheskaya Mekhanika Materialov*, vol 11, no 1, 1975, p 101, 102. In Russian

**A75-30415** Changes and evolution of aircraft engine materials. E F Bradley and M J Donachie (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.) *Metals Engineering Quarterly*, vol 15, May 1975, p 55-59

The current work reviews some of the important jet engine material changes that have occurred during the past two decades, considering both the cold and hot sections of the engine. The introduction of titanium alloys to replace steel in the low-temperature regions of the engine, the increased use of the gamma-prime nickel-base superalloys in high-temperature regions, the design of air-cooled turbine blades, and directional solidification are some of the significant advances covered. S J M

**A75-30416** Effects of quenching variables on fracture toughness of D6ac steel aerospace structures. G L Peterman and R. L. Jones (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.) *Metals Engineering Quarterly*, vol 15, May 1975, p 59-64

An experimental investigation was conducted to determine the cause of the 50% reduction in fracture toughness encountered during a routine fatigue test of a D6ac F-111 carry-through box (CTB). It is concluded that the low fracture toughness resulted from too slow a quench from the Aus-bay equalization temperature to below the martensite start temperature. As a result of the experiment, D6ac heat treatment specifications were revised to include (1) austenitizing at 1700 + or - 25 F and (2) 140 F oil quenching from 975 + or - 25 F. S J M

**A75-30426 \*** A study of KC-135 aircraft antenna patterns. W D Burnside, R J. Marhefka, C. L. Yu (Ohio State University, Columbus, Ohio), and M C Gilreath (NASA, Langley Research Center, Hampton, Va.) *IEEE Transactions on Antennas and Propagation*, vol AP-23, May 1975, p. 309-316. Grant No. NGL-36-008-133

Numerical solutions for the radiation patterns of aircraft antennas provide an excellent means of designing and locating antennas in order to achieve the desired performance. The high frequency solutions presented in this paper are based on fuselage antennas mounted on a general-type aircraft but applied specifically to the KC-135 aircraft. The roll and elevation plane patterns are computed for a monopole, axial slot, and circumferential slot mounted both above and forward of the wings. In each case the calculated patterns compare very favorably with the measured patterns. The pattern measurements were taken on a 1/25 scale model of the KC-135 aircraft at NASA (Hampton, Va.) with special emphasis on reducing the mount and background effects. (Author)

**A75-30434** Detection and discrimination of radar targets. D L. Moffatt (Ohio State University, Columbus, Ohio) and R K. Mains (Michigan University, Ann Arbor, Mich.) *IEEE Transactions on Antennas and Propagation*, vol AP-23, May 1975, p. 358-367. 19 refs. Contract No. F19628-72-C-0203.

A new method of detecting and discriminating radar targets is described. The method is based on the observation that the gross structure of a radar target can be identified from scattered fields of the target at harmonic radar frequencies located just within the low-resonance region. Multiple-frequency radar scattering data and the complex natural resonant frequencies of radar targets are integrated into a predictor-correlator processor. The method is

illustrated using both classical shapes and simple-geometry thin-wire configurations as target models. Integration programs are used to calculate multiple frequency backscatter data for the wire geometries and to deduce the complex natural resonant frequencies of the wire structures. Discrete multiple frequency radar scattering data spanning a particular spectral range are shown to be desirable for optimum capability. S J M

**A75-30491 #** Characteristics of the turbulent boundary layer at a smooth disk rotating in a large volume (Kharakteristiki turbulentnogo pogranichnogo sloia gladkogo diska, vrashchaisushchegosia v bol'shom ob'eme). V. Ia. Kabkov (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Teplofizika i Teplotekhnika*, no. 28, 1974, p 119-124. 6 refs. In Russian.

Experimental studies were made of the characteristics of the turbulent boundary layer at a disk rotating in a large volume with Reynolds numbers in the range 310,000-664,000. A smooth aluminum disk, 350 mm in diameter, rotating at 800-4000 rpm, was used. It is found that the experimental data do not support theoretical assumptions made by Dorfman (1960) and Gregory (1955) concerning the variation of the angle formed by the total velocity vector and the peripheral direction. A.T.S.

**A75-30493 #** Influence of twisting the main flow on the efficiency of film heating with axially symmetric flow around a cylinder (Vliianie zakrutki osnovnogo potoka na effektivnost' plenoch'nogo nagreva pri osesimmetrichnom obtekanii tsilindra). V M Repukhov and K A Bogachuk-Kozachuk (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Teplofizika i Teplotekhnika*, no. 28, 1974, p 139-143. In Russian.

Experimental studies were made of the effect of twisting the main part of a longitudinal flow around a cylinder on the effectiveness of cooling an adiabatic wall behind a tangential slit. The efficiency of the film cooling is found to vary complexly as a function of the twist angle. A semiempirical equation is obtained which generalizes the experimental results and relates the efficiency of film cooling of the wall in twisted and undistorted flows. A.T.S.

**A75-30506** Experimental and theoretical determination of thermal stress and heat transfer for a turbine blade, using high-temperature thin film thermocouples. D F Simbirskii, V G Bogdanov, G N Tret'iachenko, R I Kuriat, and A P Voloshchenko (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR). *(Problemy Prochnosti)*, vol 6, July 1974, p 42-47. *Strength of Materials*, vol 6, no 7, Apr 1975, p 826-831. 9 refs. Translation.

**A75-30515** Differentiation of corrosion damages according to the degree of their effect on the resistance of aircraft skin members to fatigue and corrosion-fatigue failure. A V Karlashov and N F Voronkin (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *(Problemy Prochnosti)*, vol 6, July 1974, p 106-109. *Strength of Materials*, vol 6, no 7, Apr 1975, p. 890-893. Translation.

**A75-30572** Analysis of airborne VHF incidental noise over metropolitan areas. II - Horizontal dipole antenna. E N Skomal (Aerospace Corp., El Segundo, Calif.) *IEEE Transactions on Electromagnetic Compatibility*, vol. EMC-17, May 1975, p. 77-84. 12 refs.

Computation of the incidental, quasi-peak electric field intensity detected by an airborne, tuned, horizontal dipole antenna has been performed using a symmetrical representation of measured, surface man-made incidental radio noise data and the radiation field integral

for the observed power at a height,  $h$ , above the surface. The derived electric field intensity as a function of observer altitude is compared with the results of four sets of measurements obtained over central Tokyo by Ishida for heights lying between 0.3 and 3 km. The comparisons reveal that the dependence upon altitude of the predicted quasi-peak electric field strength agrees with the observed trends and, further, that the measured and predicted field intensities display an average difference of less than 0.7 dB. These results and experimental comparisons for a tuned, airborne, horizontal dipole antenna complement the experimental confirmations of a comparable analysis previously reported for vertical, tuned, airborne dipole and monopole antennas. (Author)

**A75-30585 # Problems with bounded control variation (Zadachi s ogranicheniem na izmenenie upravleniya).** B. E. Chuprun. *Avtomatika i Telemekhanika*, Mar 1975, p 24-37. 8 refs. In Russian.

The paper considers problems in which the total variation of a control is bounded. The total variation is, roughly, the sum of the absolute values of all the rises and falls in the control action. The bound can have a physical meaning, such as the mass loss of an aircraft or the total impulse of a control force. In some cases, the total variation can measure the wear produced in an actuator during a control process. The total variation can also reflect the complexity of a programmed control. In the present paper, a necessary condition is given for the extremum for a nonlinear optimal problem in which the total variation of the control is bounded. The condition is equivalent to the condition for trajectory stationarity in a class of small control variations and small control shifts over time. A T S

**A75-30722 # Vibration of a bladed disc.** G. J. Wilson and J. Kirkhope (Carleton University, Ottawa, Canada). *CASI Transactions*, vol 7, Sept. 1974, p 41-48. 19 refs. National Research Council of Canada Grant No. A-7283.

The vibration of a disk to which are attached a large number of identical blades is considered. Exact solutions for the coupled blade-disk motion are presented for nonrotating configurations of simple geometry, the assumption being made that the blade loadings on the rim of the disk are continuously distributed around the rim. Calculated values of natural frequencies are compared with experimental data and show excellent agreement. The extension of the method to configurations more representative of turbine stages is outlined. (Author)

**A75-30723 # A turbulent boundary layer analysis of conical diffusers.** D. P. Kenny (United Aircraft of Canada, Ltd., Montreal, Canada). *CASI Transactions*, vol 7, Sept. 1974, p 49-59. 10 refs.

Conical diffusers with axisymmetric boundary layer entry conditions are considered in the analysis. A description of the approaches used in the turbulent boundary layer calculations is given, taking into account a continuity iteration procedure and a special technique which makes it possible that the boundary layer calculation can proceed beyond first separation. The results of the analysis are compared with published measurements for a wide range of throat blockages, Reynolds' numbers, cone angles, area ratios, and throat Mach numbers. G. R.

**A75-30724 # A method for the estimation of flight path perturbations during steep descents of V/STOL aircraft.** B. Etkin and H. W. Teunissen (Toronto, University, Toronto, Canada). *CASI Transactions*, vol 7, Sept. 1974, p 60-68. 11 refs. National Research Council of Canada Grant No. A-1894, Contract No. F33615-73-C-3013.

The problem of STOL and V/STOL aircraft landing along steep descent paths in congested areas through the turbulent planetary boundary layer is considered. Various approaches are discussed

toward solution of this problem in terms of estimating the probabilities associated with dispersions in the aircraft state vector at the decision height, and the details of a simplified, stationary-probe approach are presented. This method requires primarily a knowledge of the matrix of impulse response functions of the aircraft in question and a matrix of turbulence correlations representative of the atmospheric flow field. Facilities at UTIAS in which this flow field can be simulated are described, and some results of preliminary measurements of these correlations in one of the facilities are briefly mentioned. (Author)

**A75-30751 Optimal flight vehicle rotation braking.** Iu. V. Aleksandrov (*Aviatsionnaia Tekhnika*, vol 17, no 4, 1974, p 5-10.) *Soviet Aeronautics*, vol 17, no 4, 1974, p 1-5. 6 refs. Translation.

An analytic design of an optimal regulator for a class of multidimensional nonlinear systems encountered in flight vehicle rotation braking problems is presented. The nonlinear resistance of the medium and limited reaction engine thrust are considered. The synthesis procedure is based on direct solution of the Lyapunov-Bellman equation for a definite optimizing function form. The weighting coefficient in the quality functional is selected from the condition of given degree of braking at a fixed instant of time. (Author)

**A75-30755 Flight vehicle lateral static stability.** V. N. Borozdin. (*Aviatsionnaia Tekhnika*, vol 17, no 4, 1974, p 28-31.) *Soviet Aeronautics*, vol 17, no 4, 1974, p 21-23. 7 refs. Translation.

A more precise definition of the concept of lateral static stability is given. It is shown that in the formal definition of flight vehicle lateral static stability, the coefficient of lateral static stability without account for the angle of attack cannot serve as a universal criterion, as is assumed in the literature on flight dynamics. (Author)

**A75-30756 Applicability of the cross section shape invariability hypothesis in strength calculations of thinwall aircraft structures.** M. B. Vakhitov, M. S. Safariev, and A. S. Safonov. (*Aviatsionnaia Tekhnika*, vol 17, no 4, 1974, p 32-37.) *Soviet Aeronautics*, vol 17, no 4, 1974, p 24-28. 7 refs. Translation.

**A75-30757 Use of the special contour method to approximate an aerodynamic profile of arbitrary form.** Iu. V. Davydov and V. A. Osipov (*Aviatsionnaia Tekhnika*, vol 17, no 4, 1974, p 38-44.) *Soviet Aeronautics*, vol 17, no 4, 1974, p 29-34. Translation.

An extension of the special contour method developed at the Moscow Aviation Technological Institute is presented for approximating an aerodynamic profile of arbitrary form specified by discrete coordinate values. An algorithm is derived for calculating the aerodynamic contour using a form control parameter represented as a function of a specific coordinate. Given profile coordinates and values obtained with the proposed method are compared for the Arado-234, Mustang, British EC-1240, and Tokyo LB-24 profiles as well as an arbitrary profile. The results show that the proposed method provides a simple and convenient way to describe existing profiles, which is the same regardless of profile shape, and to design new profiles with a minimal amount of input. F. G. M.

**A75-30760 Mathematical modeling of fuselage-engine nacelle surface design.** O. I. Kononov and V. A. Osipov (*Aviatsionnaia Tekhnika*, vol 17, no 4, 1974, p 62-67.) *Soviet Aeronautics*, vol 17, no 4, 1974, p 49-53. Translation.



The present work examines a mathematical model of channel-type surfaces with rectilinear axes and discrete contours consisting of plane-parameterized lines representing theoretical frame contours. The contours may take on various forms (oval, rectangular, etc.) In the radial sections the surface is described by a third-degree polynomial. This study is applicable to the design and manufacture of aerodynamic surfaces with the aid of programmed control equipment. S.J.M.

**A75-30761** Analytic determination of the aerodynamic characteristics of a wing profile in potential incompressible fluid flow. N. M. Monakhov and V. F. Startsev (*Aviatsionnaia Tekhnika*, vol. 17, no. 4, 1974, p. 68-74.) *Soviet Aeronautics*, vol. 17, no. 4, 1974, p. 54-59. Translation.

Conformal transformation theory is used to construct a successive approximation method for determining the velocity distribution and aerodynamic characteristics of a profile. The velocity distribution at the profile surface and the aerodynamic characteristics are expressed in closed form. Calculation examples (cambered lune, asymmetric Zhukovskii profile) showed quite high accuracy of the formulas obtained. (Author)

**A75-30763** Fourier series solution of the 'vortex' method integral equation. Z. Kh. Nugmanov (*Aviatsionnaia Tekhnika*, vol. 17, no. 4, 1974, p. 80-85.) *Soviet Aeronautics*, vol. 17, no. 4, 1974, p. 64-68. Translation.

An approximate method is given for solving the integral Fredholm equation of the second kind obtained in constructing the potential flow around an arbitrary wing profile. The reduced velocity at the profile contour surface is represented in the form of a trigonometric series whose coefficients are found using the Bubnov-Galerkin method. (Author)

**A75-30764** Influence of actuator kinematics on flight vehicle booster control system stability. F. G. Pogodaev and G. I. Zaionchkovskii (*Aviatsionnaia Tekhnika*, vol. 17, no. 4, 1974, p. 86-90.) *Soviet Aeronautics*, vol. 17, no. 4, 1974, p. 69-72. 5 refs. Translation.

It is shown on the basis of comparative analysis of five of the most frequently used single-chamber flight vehicle control system hydraulic booster schemes, that with the real actuator attachment stiffness the power loop of booster control systems with boosters having 'inverted' kinematics has high stability margins. An estimate is made of the influence of limited booster control system power loop stiffness on the magnitude of the critical quality factor of the booster used. (Author)

**A75-30772** Conditional extremum problem solution method for generalized functionals and its application to hypersonic gasdynamic problems. A. I. Bunimovich and A. V. Dubinskii (*Aviatsionnaia Tekhnika*, vol. 17, no. 4, 1974, p. 129-132.) *Soviet Aeronautics*, vol. 17, no. 4, 1974, p. 108-111. 5 refs. Translation.

**A75-30775** Effectiveness of operation in turbulent atmosphere of the lateral channels of a VTOL airplane vector stabilizing system. V. I. Pentukhov and V. F. Kriger (*Aviatsionnaia Tekhnika*, vol. 17, no. 4, 1974, p. 139-142.) *Soviet Aeronautics*, vol. 17, no. 4, 1974, p. 119-122. Translation.

**A75-30851** Ceramics for high-performance applications; Proceedings of the Second Army Materials Technology Conference,

Hyannis, Mass., November 13-16, 1973. Conference sponsored by the US Army. Edited by J. J. Burke, A. E. Gorum, and R. N. Katz (US Army, Army Materials and Mechanics Research Center, Watertown, Mass.). Chestnut Hill, Mass., Brook Hill Publishing Co., 1974. 781 p. \$36.

A series of papers dealing with the development of ceramic materials and design technology for high-performance applications, especially in gas-turbine engines. Problems of design, materials processing and fabrication, materials and component evaluation, nondestructive evaluation, and component development are covered. The topics discussed include ceramics in small vehicular gas turbines and in gas turbines for electric-power generation, the design of ceramic turbine rotors and stationary vane assemblies, the production of high-temperature, high-strength nitrogen ceramics, high-temperature slow crack growth in ceramic materials, oxidation and corrosion-erosion behavior of Si<sub>3</sub>N<sub>4</sub> and SiC, and reliability, life prediction, and proof testing of ceramics.

A T S

**A75-30852** Probability-based design and analysis - The reliability problem. E. M. Lenoe (US Army, Army Materials and Mechanics Research Center, Watertown, Mass.). In Ceramics for high-performance applications, Proceedings of the Second Army Materials Technology Conference, Hyannis, Mass., November 13-16, 1973. Chestnut Hill, Mass., Brook Hill Publishing Co., 1974, p. 123-145. 16 refs. ARPA-supported research.

The general problem of engine reliability is discussed prior to reviewing probability-based design and analysis techniques. Typical aircraft turbine engine reliability growth during early service life can involve a threefold reduction in unscheduled engine removal rates. Reasons for this characteristic maturing of reliability are presented. This maturation of reliability emphasizes the importance of variability introduced by analytical inadequacies, as well as inherent variabilities in material strength. With regard to the ceramic engine application, statistical models for strength and modulus of hot-pressed silicon nitride are presented and discussed. A specific example is given of probability of failure computations for deterministic mechanical and thermal stresses in the first-stage rotor of the vehicular engine project. (Author)

**A75-30860** The production of high-temperature, high-strength nitrogen ceramics. K. H. Jack (Newcastle-upon-Tyne, University, Newcastle-upon-Tyne, England). In Ceramics for high-performance applications, Proceedings of the Second Army Materials Technology Conference, Hyannis, Mass., November 13-16, 1973. Chestnut Hill, Mass., Brook Hill Publishing Co., 1974, p. 265-286. 16 refs.

In the present work it is argued that hot-pressed alpha-silicon nitride powder does not give the highest intrinsic strengths, but that the Si<sub>3</sub>N<sub>4</sub> or silicon-aluminum-oxynitrides and related phases, do provide higher-strength, lower-porosity products. Si<sub>3</sub>N<sub>4</sub> particles have a coating of silica on them which acts as a second phase, this phase can melt at high temperatures and act as a stress raiser or initiate cracks because of its different thermal expansion relative to the matrix. But the surface silica and structural oxygen associated with alpha-silicon nitride can both be accommodated in a single-phase beta-prime-Sialon, which can also retain other metal oxides in solid solution. Within the wide range of homogeneity of the beta-prime-phase, different compositions can be selected for hot pressing and for pressureless sintering. S. J. M.

**A75-30869 \*** High gas velocity burner tests on silicon carbide and silicon nitride at 1200 C. W. A. Sanders and H. B. Probst (NASA, Lewis Research Center, Cleveland, Ohio). In Ceramics for high-performance applications, Proceedings of the Second Army Materials Technology Conference, Hyannis, Mass., November 13-16, 1973. Chestnut Hill, Mass., Brook Hill Publishing Co., 1974, p. 493-531. 18 refs.

Ten SiC materials and five Si<sub>3</sub>N<sub>4</sub> materials were exposed in a Mach 1-gas-velocity burner simulating a gas-turbine engine environment. All materials studied are commercially available. Cyclic tests up to 100 hours' duration were conducted at specimen temperatures of 1200 C. A specimen geometry was used that develops thermal stresses during thermal cycling in a manner similar to blades and vanes of a gas turbine engine. Materials were compared on a basis of weight change, dimensional reductions, metallography, fluorescent-penetrant inspection, X-ray diffraction analyses, failure mode, and general appearance. One hot-pressed SiC, one reaction-sintered SiC, and three hot-pressed Si<sub>3</sub>N<sub>4</sub> materials survived the program goal of 100 one-hour cycles of exposures. Of the materials that failed to meet the program goal, thermal fatigue was identified as the exclusive failure mode. (Author)

**A75-30872** Lubricant interaction with silicon nitride in rolling contact applications. Y. P. Chiu and H. Dalal (SKF Industries, Inc., King of Prussia, Pa.) In *Ceramics for high-performance applications*, Proceedings of the Second Army Materials Technology Conference, Hyannis, Mass., November 13-16, 1973.

Chestnut Hill, Mass., Brook Hill Publishing Co., 1974, p. 589-607. 10 refs. Research supported by the SKF Industries, Contract No. N00019-73-C-0150.

The lubrication response of silicon nitride, measured in terms of contact angle, lubricant film thickness, and traction coefficient, was found to be comparable with that of M50 tool steel presently used for aircraft engine bearings. Friction and wear properties in the lubricated and unlubricated state were evaluated. The investigation indicated that silicon nitride can be satisfactorily lubricated by hydrocarbon and ester base lubricants up to 500 F. (Author)

**A75-30873** Prototype ceramic vanes. C. G. Nessler (United Aircraft Corp., Pratt and Whitney Aircraft Div., Middletown, Conn.) In *Ceramics for high-performance applications*, Proceedings of the Second Army Materials Technology Conference, Hyannis, Mass., November 13-16, 1973. Chestnut Hill, Mass., Brook Hill Publishing Co., 1974, p. 609-630. 11 refs.

Ceramic vanes offer significant potential in large aircraft and industrial gas turbines. The suitability of hot-pressed silicon nitride for use in current engine vanes was preliminarily evaluated. Prototype vane construction and testing were undertaken together with closely related material characterization. The results indicated that cyclic thermal stress and impact behavior especially warrant more attention. Establishing material performance criteria and comparing test data with them are important needs. Design and construction of experimental parts are the necessary next steps to accurately determine the utility of hot-pressed ceramics. (Author)

**A75-30879** Application of ceramics to radial flow gas turbines at Solar. A. G. Metcalfe (International Harvester Co., Solar Div., San Diego, Calif.) In *Ceramics for high-performance applications*, Proceedings of the Second Army Materials Technology Conference, Hyannis, Mass., November 13-16, 1973.

Chestnut Hill, Mass., Brook Hill Publishing Co., 1974, p. 739-747. 6 refs.

Previous analyses of ceramics under stringent combustor control and dust ingestion service conditions indicating that ceramic nozzle guide vanes and shrouds would provide efficient solutions to these problem conditions were confirmed by tests on a small turbine. It is suggested that this type of application involves much less risk than those applications requiring the development of an all-ceramic engine, and that it may represent an effective approach for introducing ceramics to gas turbines. The U.S. Army (MERDC) 10-kW gas turbine generator is examined in illustration of these views. S. J. M.

**A75-30880** Turbine vane ceramic endwall. C. W. Hayes, C. G. Nessler (United Aircraft Corp., Pratt and Whitney Aircraft Div.,

East Hartford, Conn.), and D. Zabierek (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). In *Ceramics for high-performance applications*, Proceedings of the Second Army Materials Technology Conference, Hyannis, Mass., November 13-16, 1973.

Chestnut Hill, Mass., Brook Hill Publishing Co., 1974, p. 749-761. Contract No. F33615-73-C-2066.

A hot-pressed silicon nitride gas turbine vane platform or endwall is being designed, constructed, and tested in a program sponsored by the Air Force Aero-Propulsion Laboratory. The program plan, material selection, design criteria, and planned stress analysis are described. The current status of the ongoing work is indicated. (Author)

**A75-30889** Aperiodic unsteady transonic flows (Aperiodische instationäre schallnahe Strömungen). S. Turbatu (Bucuresti, Universitatea, Bucharest, Rumania) and J. Zierep (Institut für Stromungslehre und Stromungsmaschinen, Karlsruhe, West Germany). *Acta Mechanica*, vol. 21, no. 1-2, 1975, p. 165-169. 8 refs. In German.

The procedures of the parabolic method are used in a generalized approach to investigate the characteristics of special unsteady flows. Attention is given to cases in which unsteady conditions due to an instantaneous process occur. The differential equation describing the unsteady characteristics of a transonic flow about slender bodies is considered. The solution discussed makes use of an approach described by Oswatitsch (1964). G. R.

**A75-30898** Numerical study of the flow of an incompressible viscous fluid around a fixed or rotating cylinder - Magnus effect (Etude numérique de l'écoulement d'un fluide visqueux incompressible autour d'un cylindre fixe ou en rotation - Effet Magnus). T. P. Loc (CNRS, Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur, Orsay, Essonne, France). *Journal de Mécanique*, vol. 14, no. 1, 1975, p. 109-134. 24 refs. In French.

This paper presents a study of the steady viscous incompressible flow past a circular cylinder at rest then in rotating motion. The effects of the Reynolds number and the rotating speed of the cylinder on the formation and the structure of the wake are investigated. Finite-difference scheme of predictor-corrector type is used to solve the Navier-Stokes equations. Solutions for the fixed cylinder were obtained for Re equals 5, 20, 40, 60, 100 and 120. The problem corresponding to the rotating cylinder which necessitates a special treatment of boundary conditions because of the existence of numerical instabilities, have been studied for Re equals 5 and 20. Drag and lift coefficients are compared with existent experimental results. Magnus effect is analyzed. (Author)

**A75-30930** Measurement of the M number in plasma jets. N. P. Kozlov, L. V. Leskov, Iu. S. Protasov, V. I. Khvesiuk, and V. V. Iaminskii (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR). (*Teplofizika Vysokikh Temperatur*, vol. 12, July-Aug. 1974, p. 697-704). *High Temperature*, vol. 12, no. 4, Mar. 1975, p. 609-615. 28 refs. Translation.

The Mach number of hypersonic jets ejected by strong-focusing coaxial plasma accelerators was measured from the Mach reflection at a plate with a sharp leading edge placed at an angle of attack at various distances from the nozzle exit section. It is shown that the limitations of the method (depending on the flow conditions) can be removed by measuring local Mach numbers with a flat electric probe one side of which is insulated. Knowing the direction of the velocity vector of the flow, it is sufficient to determine the ion saturation current for two orientations of the probe. V. P.

**A75-30994** Chemical reactions calculations in turbulent flows - Application to a co-containing turbojet plume. R. Borghi (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). In

Turbulent diffusion in environmental pollution, Proceedings of the Second Symposium, Charlottesville, Va., April 8-14, 1973 Volume B New York, Academic Press, Inc., 1974, p 349-365 15 refs

The isobaric mixing of a multispecies jet with air at rest can be described by a set of steady balance equations. The flow pattern of the mixing and reaction zone of the turbojet plume is examined. The effects of turbulence are investigated, taking into account an exact expression of the mean reaction rate, the balance equations, and a turbulence model. It is found that the total mass flow rate of CO delivered by the jet decreases rapidly within a short length from the exhaust section. G R

**A75-30998 # Optimization of the parameters of multipurpose flight vehicles (Optimizatsiya parametrov mnogotselevykh letatel'nykh apparatov).** S A Pilyavskii, V S Brusov, and E A Khvilon. Moscow, Izdatel'stvo Mashinostroenie, 1974 168 p 16 refs. In Russian

The present work examines the optimization of multipurpose systems, characterized by a manifold of tasks to be carried out, a vectorial efficiency index, and the presence of many elements. The properties of these systems are mathematically analyzed, in particular, their efficiency. Methods of representing the characteristics of elements of hierarchical multipurpose systems are set forth. P T H

**A75-30999 # Estimation of the strength and mass of thin-walled structures (Otsenka prochnosti i massy tonkostennyykh konstruktsii).** L D Arson, L A Malashenko, and V M Sapozhnikov. Moscow, Izdatel'stvo Mashinostroenie, 1974 152 p 32 refs. In Russian

Methods are described for calculating the strength, stiffness and mass of thin-walled structures with account taken for possible deviations in the dimensions and properties of the materials. The methods are founded on the theory of probability and mathematical statistics. P T H

**A75-31000 # Flight control and efficiency of an aviation complex (Upravlenie poletom i effektivnost' aviatsionnogo kompleksa).** V V Andreevskii and L B Goroshchenko. Moscow, Izdatel'stvo Mashinostroenie, 1974 176 p 40 refs. In Russian

The book discusses modern methods used for evaluating the technical characteristics of an aeronautical complex from the point of view of the efficiency of flight operations. General problems involved in modeling operations and predicting the efficiency of engineering systems are considered. An examination is made of possible ways of simplifying models of flight operations and their stages. The accuracy of the modeling approach is evaluated. The book discusses the choice of criteria for flight-operations efficiency, the planning of optimally efficient maneuvers, and the plotting of trajectories in general. Methods are given for optimizing trajectories when supplementary relationships and constraints, arising out of particular aircraft applications, are encountered. A T S

**A75-31001 # Study of the white corona from Concorde 001 during the total solar eclipse of June 30, 1973 (L'étude de la couronne blanche à bord de Concorde 001 au cours de l'éclipse totale de soleil du 30 juin 1973).** S Koutchmy (CNRS, Institut d'Astrophysique, Paris, France). *L'Astronomie*, vol 89, Apr 1975, p 149-157. In French

Preliminary preparations, essential results, and a narrative account of the high-resolution coronal photography experiment conducted aboard the Concorde 001 during the recent African solar eclipse are presented. Scientific and other objectives of the study are considered, the camera used is described, and the performance of the camera is evaluated. S J M

**A75-31053 F-15 Eagle.** M Wilson. *Flight International*, vol 107, May 1, 1975, p 703-714

Design studies, design techniques, flight control, weapons, ease of maintenance, early engine difficulties, and a detailed cutaway diagram of the McDonnell-Douglas F-15A Eagle are presented and discussed. The craft is believed to be a match for the long-superior Soviet MiG-25 Foxbat. The F-15 set eight official world time-to-height records early this year. It is 2 ft longer and 3 ft wider than the F4E Phantom, although its takeoff weight is some 7000 lb less than that of the Phantom. S J M

**A75-31086 The influence of temperature on shock-free supersonic jet noise.** H K Tanna, P D Dean (Lockheed-Georgia Co., Marietta, Ga.), and M J Fisher (Southampton, University, Southampton, England). *Journal of Sound and Vibration*, vol 39, Apr 22, 1975, p 429-460 12 refs. Contract No F33615-73-C-2032

The effect of flow temperature on the sound field of supersonic shock-free jets is studied experimentally by measuring the turbulent mixing noise in the far-field from four 2-inch diameter nozzles situated in an anechoic room that provides a free-field environment. To minimize additional problems of convective amplification and refraction, the effects of temperature on mixing noise source strengths are evaluated by examining the data at 90 deg to the jet axis only. It is shown that there are in general two sources of noise: a source which results from Reynolds shear stress fluctuations, and a source which is attributed to density or temperature fluctuations promoted by the turbulent mixing of streams with dissimilar temperatures. Highly correlated scaling laws for the velocity and temperature dependencies of the spectra of these noise components are obtained and verified. S D

**A75-31092 \* Improved solution for potential flow about arbitrary axisymmetric bodies by the use of a higher-order surface source method.** J L Hess (Douglas Aircraft Co., Long Beach, Calif.). *Computer Methods in Applied Mechanics and Engineering*, vol 5, May 1975, p 297-308 9 refs. Contract No NAS3-18018

An investigation is conducted of a case of axisymmetric bodies in which the application of main interest is an inlet, possibly with centerbody and ring vanes. The technique employed makes use of curved surface elements and a source density which varies over the element. Such an approach is designated a higher-order implementation. Questions of surface element geometry are discussed along with the computation of the induced velocity matrices and the organization of the calculation. The calculated results are compared with analytic solutions. G R

**A75-31110 Meeting conflicting hydraulic design goals of the F-14A.** G J Pinelli and J M Morrison (Grumman Aerospace Corp., Bethpage, N.Y.). *Hydraulics and Pneumatics*, vol 28, May 1975, p 64-66

An overall hydraulic view, hydraulic design goals, fail-safe operation, improved combat survivability, low-weight design, and ease of maintenance are discussed for the F-14A Tomcat fighter. The Tomcat has two independent, engine-powered hydraulic systems, supplemented by two electric-motor-driven power modules, a bidirectional power transfer unit (two motor/pumps), and a cockpit hand pump. S J M

**A75-31193 Maximum-performance takeoffs of heavily-loaded helicopters.** F H Schmitz and C R Vause (U.S. Army, Air Mobility R & D Laboratory, Moffett Field, Calif.). *Vertiflite*, vol 21, Mar-Apr 1975, p 10, 11, 33

A simple, near-optimal takeoff control policy has been developed for heavily-loaded helicopters operating from a restricted area. The maneuver consists of a maximum acceleration segment and a climb segment. Rotation and climb commence at a 'critical' rotation

perience, the use of digital computers in military aircraft, and an airline's experience with digital systems. Future developments in the area of airborne digital systems are also considered

Individual items are announced in this issue

G R.

**A75-31292**      **Realism in fatigue testing - The effect of flight-by-flight thermal and random load histories on composite bonded joints.** D J. Wilkins, R. V. Wolff, E F Cox (General Dynamics Corp., Fort Worth, Tex.), and M. Shinozuka (Columbia University, New York, N.Y.) In *Fatigue of composite materials*, Proceedings of the Symposium, Bal Harbour, Fla., December 3, 4, 1973. Philadelphia, Pa., American Society for Testing and Materials, 1975, p. 307-322. 9 refs. Contract No. F33615-72-C-2060

An investigation was conducted concerning the feasibility of studying fatigue aspects of large-scale components in laboratory simulations of realistic service conditions. Realism criteria for the design of simulation tests are examined and the development of a realistic fatigue spectrum for an advanced composite bounded joint is discussed, taking into account the creation of a digital computer procedure for producing the spectrum. The load control system and the environmental control system of the laboratory facility used in the project are considered along with details regarding the testing program

G R

**A75-31377**      **Effect of nonstationarity on aerodynamic forces in an airfoil cascade.** V. P. Vakhomchik (*Problemy Prochnosti*, vol. 6, Aug. 1974, p. 14-22) *Strength of Materials*, vol. 6, no. 8, May 1975, p. 923-931. 5 refs. Translation

A cascade of thin slightly bent airfoils without a stagger angle, spinning at a constant rate in plane irrotational incompressible inviscid flow at a small angle of attack is examined. The airfoils perform small synchronous vibrations with a constant phase shift at neighboring airfoils. The portions of the unsteady lifting force and moment, generated by trailing vortex systems which form in unsteady flow, are analyzed. Analytical quadrature expressions for the unsteady portion of the lifting force and moment are derived, along with asymptotic formulas for the unsteady portion of the lifting force for small and large Strouhal numbers and airfoil spacings under conditions of inphase and antiphase vibrations

V.P

**A75-31378**      **Nonsteady aerodynamic lattice characteristics of thin, curvilinear profiles.** V. E. Saren (Akademiya Nauk SSSR, Institut Gidrodinamiki, Novosibirsk, USSR) (*Problemy Prochnosti*, vol. 6, Aug. 1974, p. 23-28) *Strength of Materials*, vol. 6, no. 8, May 1975, p. 932-937. 6 refs. Translation

The transient aerodynamic characteristics are calculated for a range of geometrical cascade parameters and flow conditions characteristic of compressors. It is shown that the curvature of the airfoil profile and the magnitude of the steady load at the airfoils are decisive factors in the calculations. Because of this, calculations based on the model of a lattice of plates vibrating at zero-angle of attack are seen to be of limited applicability. The use of aerodynamic influence coefficients for describing the aerodynamic properties of vibrating airfoils in cascade is shown to be convenient and universal

V P

**A75-31380**      **Experimental study of the aerodynamic interaction in a cascade of vibrating blades.** A. E. Korostelev (RKIIGA, Riga, Latvian SSR) (*Problemy Prochnosti*, vol. 6, Aug. 1974, p. 34-40) *Strength of Materials*, vol. 6, no. 8, May 1975, p. 943-949. 9 refs. Translation

The forced-vibration type facility described makes it possible to obtain the unsteady aerodynamic forces in a plane cascade, in terms of Kursin's (1964) aerodynamic influence coefficients. The aerodynamic influence coefficients are factors of proportionality

between the aerodynamic force acting on one blade and the displacement of another blade. The flow at an angle of attack through a cascade in which only two blades vibrate is analyzed

V.P.

**A75-31386**      **Flutter of dynamically nonuniform airfoil cascades in potential flow.** A. N. Fedosova (*Problemy Prochnosti*, vol. 6, Aug. 1974, p. 68-72) *Strength of Materials*, vol. 6, no. 8, May 1975, p. 980-984. 5 refs. Translation

The conditions for the excitation of torsional mode shapes of vibration are determined for both dynamically homogeneous and inhomogeneous cascades. Use is made of the transient aerodynamic force coefficients obtained by Saren (1972) for potential incompressible flow through curved airfoils in cascade, and of those obtained by Gorelov (1971) for zero-incidence compressible flow through plane airfoil cascades. The influence of such geometrical cascade parameters as the blade angle, spacing, and blade curvature, and the influence of the Mach number and angle of attack on the critical reduced frequency is demonstrated

V.P

**A75-31415**      **Aeronautical bolting and high-performance bolting (Boulonnerie aéronautique et boulonnerie haute performance).** J. Ordines (Société Blanc Aero, Paris, France) *Matériaux et Techniques*, vol. 63, Mar.-Apr. 1975, p. 115-121. In French

Technical and economic factors are considered in a discussion of the importance of choice of material, accuracy requirements, conditions for fastener use, and the effects of these parameters on aircraft production methodology. The advantages that could ensue from a policy of open discussion and tighter standardization for airframe manufacturers, steelmakers, and fastener producers are analyzed

S.J.M

**A75-31421**      **DLS - New generation landing aid.** M. Bohm and G. Peuker (Standard Elektrik Lorenz AG, Stuttgart, West Germany) *Electrical Communication*, vol. 50, no. 1, 1975, p. 70-76

A new landing system proposal designated DLS (DME-based landing system, DME equals distance measuring equipment) is discussed. The system measures azimuth and elevation from the incidence of the aircraft's air-to-ground interrogating signals and transmits this angle information back to the aircraft. Advantages of DLS are outlined, among them are a good performance/cost ratio and the need to make only small modifications on existing systems in order to be implemented. The system can be operated wholly on those terminal DME frequency channels that are already allocated for use with ILS

S.J.M

**A75-31422**      **The motion of aircraft trailing vortices.** T. Maxworthy (Southern California, University, Los Angeles, Calif.) *American Society of Mechanical Engineers, Applied Mechanics Western Conference, University of Hawaii, Honolulu, Hawaii, Mar. 25-27, 1975, Paper 75-APMW-58*. 4 p. 8 refs. Members, \$100, nonmembers, \$3.00. NSF Grant No. GK-38147X1

Knowledge of the motion of turbulent vortex rings is used to speculate upon the dynamical characteristics of the trailing vortex pair which forms the wake of a lifting surface. An interpretation is presented of common observations which suggests that the gross features of the two systems are similar, at least before the aircraft wake distorts due, among other things, to a self-induced instability. The theory presented by Maxworthy (1974) is extended to the two-dimensional case and predictions of the shape of aircraft trails are displayed in nondimensional form. As a special case a preliminary prediction is given for the wake shape of a 747, in cruise condition, for a set of parameters that are only approximately correct. Only comparison with actual observations can further refine these guesses. Unfortunately the required observations are not available for any aircraft type. However, the present work suggests a program of

measurements which would help in narrowing the possible parameter range. Comments on the motion of vortex rings and vortex pairs in a stratified atmosphere complete the presentation. (Author)

**A75-31424 \* # Experiments on supersonic boundary-layer separation in three dimensions.** W D Bachalo (California, University, Berkeley, NASA, Ames Research Center, Moffett Field, Calif.) *American Society of Mechanical Engineers, Applied Mechanics Western Conference, University of Hawaii, Honolulu, Hawaii, Mar. 25-27, 1975, Paper 75-APMW-55* 6 p 13 refs. Members, \$1 00, nonmembers, \$3 00. NASA-sponsored research.

A detailed experimental study of three-dimensional separation in supersonic flow is described. Three-dimensional wedges affixed to flat plates were used to generate the flow fields that were used to examine the relationship of cross flow to the extent of separation. Models with strong transverse pressure gradients resulted in a diminished extent of separation about the model plane of symmetry but demonstrated expansive growth of separation to a limit with distance from the plane of symmetry. A secondary flow region was found embedded in the separated flow. (Author)

**A75-31443 # First ADE for Air Force information systems.** A P Pennock (Lockheed-Georgia Co., Marietta, Ga.) and W H Dickson (Lockheed Electronics Co., Inc., Plainfield, N.J.) *Astronautics and Aeronautics*, vol 13, May 1975, p 62-66.

Automatic data entry (ADE) offers a chance to improve further Air Force maintenance procedures. ADE encompasses all mechanical devices which replace manual entry of data into an information system by automatic entry. The utility of ADE procedures for the Air Force are considered, taking into account also aerospace applications far beyond the Air Force's maintenance information systems. G R

**A75-31562 # Circuit design of a forced hydrogen cooling system (Konturnost' sistemy prinuditel'nogo okhlazhdeniia vodorodom).** I N Moisheev *Teplofizika Vysokikh Temperatur*, vol 12, Nov-Dec 1974, p. 1257-1266. In Russian.

The present paper considers the problem of circuit design for a forced hydrogen cooling system for aircraft subjected to high heat loads. The hydrogen in such systems is used both as a fuel and as a coolant. Two methods of using the hydrogen are compared: a single-circuit method and a double-circuit method. In the single-circuit system, the hydrogen flows directly in a cooling jacket, where it is heated. In the double-circuit system, the aerodynamically generated heat is accumulated by a high-temperature heat-transfer agent which circulates in a closed circuit, then the heat is transferred to the hydrogen coolant in a high-temperature heat-exchanger. A liquid-metal heat-transfer agent is used in the present case. It is shown that the double-circuit system can offer considerable advantages over a single-circuit system, especially for high heat loads. A T S

**A75-31583 # Effect of thickness in the calculation of the aerodynamic forces generated on an oscillating wing (Effetto dello spessore nel calcolo di forze aerodinamiche generalizzate su un'ala oscillante).** P Santini, O Carlini, and L Ognibene (Roma, Università, Rome, Italy). In *Meteorological and earth-resources satellites - Special technologies - International Collaboration, International Symposium on Space, 14th, Rome, Italy, March 18-20, 1974, Proceedings*. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1974, p 153, 155-159. In Italian.

The problem of the simulation of a lifting surface of finite thickness is investigated, taking into account a representation by an unknown distribution of singularities on the upper and lower parts. A number of formulas related to the steady case are presented. The problem can be considered as an extension of the infinitesimal thickness case by making use of a simple transformation. G R

**A75-31801 # Motion of a spanwise semielliptical wing near the ground (Dvizhenie poluellipticheskogo po razmakhu kryla vblizi ekranu).** P I Zinchuk (Akademiia Nauk Ukrainskoi SSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR) and A I Lukhimenko (Kievskii Avtodorozhnyi Institut, Kiev, Ukrainian SSR) *Gidromekhanika*, no 28, 1974, p 61-69. 8 refs. In Russian.

The three-dimensional problem of the steady translational motion at a small angle of attack of a ground-effect wing shaped as a semielliptical lifting line (both tips of which are close to the ground) is analyzed. A general integral equation for calculating the density of the vortex sheet is derived, along with expressions for determining the lift coefficient, the induced drag, and the geometrical parameters of the minimum-induced-drag configuration of the wing. V P

**A75-31807 # Contribution to the asymptotic theory of a wing of average aspect ratio (K asimptoticheskoi teorii kryla srednego udlineniia).** I I Efremov (Akademiia Nauk Ukrainskoi SSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR) *Gidromekhanika*, no 29, 1974, p 10-13. 6 refs. In Russian.

A solution of the integral equation for a wing of finite span is obtained on the basis of an approximation proposed by Lawrence (1951). The solution has the form of a series in powers of the inverse aspect ratio. The Lawrence approximation is also used to derive a formula for calculating the lift coefficient of a wing of arbitrary aspect ratio. An analogous formula for a supercavitating wing of finite span is obtained. V P

**A75-31813 # Calculation of supercavitating flow through thin airfoil cascades by the method of integral equations (Raschet superkavitatsionnogo obtekanii reshetok tonkikh profilov metodom integral'nykh uravnenii).** I I Efremov and M E Marko (Akademiia Nauk Ukrainskoi SSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR) *Gidromekhanika*, no 29, 1974, p 38-43. 5 refs. In Russian.

A system of integral equations for calculating the characteristics of an airfoil in a cascade for supercavitating flow is solved by the method of discrete singularities. The dependence of the cavitation number and lift coefficient on the lattice pitch is determined. V P

**A75-31814 # Maximal and mean values of the hydrodynamic characteristics of a wing moving above an uneven surface (Maksimal'nye i srednie znachenii gidrodinamicheskikh kharakteristik kryla, dvizhushchegosia nad neploskim ekranom).** V G Belinskii, P I Zinchuk, V N Neznamov, V A Orishchev, and S I Putilin (Akademiia Nauk Ukrainskoi SSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR) *Gidromekhanika*, no 29, 1974, p 43-45. In Russian.

**A75-31842 # Considerations concerning the semiautomatic and automatic control of the aircraft in the case of a given flight path (Betrachtungen zur halbautomatischen und automatischen Steuerung des Flugzeuges bei vorgegebener Flugbahn).** D Oehme (Gesellschaft für internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol 11, no 1, 1975, p 8-18. In German.

The characteristics of the aircraft control process are examined, taking into account the function of the pilot in a closed-loop system. The control of lateral motion during the landing maneuver is considered along with the principles of semiautomatic control of the flight in accordance with the prescribed flight path. Attention is also given to the design principles of automatic systems, the derivation of the relations concerning the control of the aircraft in the horizontal plane, and details of aircraft control during the approach. G R

**A75-31844 # Specific properties of high-strength and heat-resistant wrought aluminum alloys and the consideration of these properties in the maintenance of aircraft I (Spezifische Eigenschaften hoch- und warmfester Al-Knetlegierungen und deren Beachtung bei der Instandhaltung von Flugzeugen. I).** L Ahnert

(VEB Kombinat Spezialtechnik, Dresden, East Germany) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol 11, no 1, 1975, p 26-28, 33-39 13 refs In German.

The performance of maintenance and repair operations requires presently a knowledge of modern criteria for the evaluation of materials. The properties of five important aluminum alloys are examined as a basis for the discussion of the factors which have to be taken into account for a selection of a suitable material in case of an exchange of materials. Attention is given to questions concerning the isotropy of the mechanical properties, aspects of fatigue strength, and crack formation and propagation G R

**A75-31845 #** Basic concepts concerning the operational technology of air traffic (Grundsätzliche Vorstellungen zur Betriebstechnologie des Luftverkehrs). R Kuttner (Gesellschaft für Internationalen Flugverkehr MbH, Berlin, East Germany) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol 11, no 1, 1975, p 43-46 In German

The technology considered is concerned with the interaction of people and equipment in the performance of the functions required for the transportation of persons, luggage, and freight by air. The interaction, which takes place according to a preconceived plan or schedule, is related to groups of procedural functions. These groups of functions are partly the result of contacts between the clients and the installations provided for the traffic operations. Other functional groups are connected with the relation between the aircraft and the other components of the air transportation system, including the maintenance system, the airspace, and the installations for the traffic operations G R

**A75-31846 #** The regimes of climbing flight (Regime des Steigfluges). S Skripnichenko (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskogo Vozdushnogo Flota, Moscow, USSR) (*Grazhdanskaya Aviatsiya*, no 7, 1973, p 24, 25) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol 11, no 1, 1975, p 47-51 In German (Translation)

The characteristics of optimum climbing flight depend on a number of factors related to the general traffic situation in the airspace, the presence of obstacles, and meteorological conditions. Corresponding to these factors the optimum climbing flight conditions can be represented by one of four flight regimes. These regimes include the regime of maximum climb rate, the economic or speed regime of climbing flight, a regime based on minimum fuel consumption during the entire flight, and a regime depending on minimum distance considerations. A description of the four regimes is provided, giving attention to questions of suitable regime selection G R

**A75-31848 #** The Dolphin airship with undulating propulsion - Forward thrust of deundulators of great depth (Delphinluftschiff mit Wellantrieb - Vortrieb von Entwellern grosser Tiefe). W Schmidt (Kammer der Technik, Arbeitsausschuss zum Studium der Luftschiffahrt, Dresden, East Germany) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol 11, no 1, 1975, p 56-60 7 refs In German

An experimental investigation was conducted to study the effects produced by a 'rotating undulator' and a 'deundulator'. The 'rotating undulator' imparts an undulatory motion to the air current. The device consists of a rotating airfoil which moves alternately upward and downward. The 'deundulator' is a fixed airfoil which eliminates the undulatory motion generated by the undulator. The forward thrust obtained for various operational and device-design conditions is discussed, giving particular attention to the parameter characteristics for which the forward thrust begins to disappear. G R

**A75-31857 #** Modern hubs of helicopter rotors I (Współczesne piasty wirników śmigłowcowych I) Z Brodzki *Technika Lotnicza i Astronautyczna*, vol 29, Apr 1975, p 13-16 In Polish.

The progress made during the past few years in the design and construction of helicopter rotor hubs is reviewed. The rotating and static elements of some modern rotor hubs are discussed and illustrated, and rotor hub design criteria are tabulated V.P.

**A75-31859 #** Determination of the pitching moment coefficient for a glider without control surfaces on the basis of in-flight measurements (Wyznaczenie współczynnika momentu pochylającego dla szybowca bez usterzenia na podstawie pomiarów w locie) W Stafiej (Ośrodek Badawczo-Rozwojowy Szybownictwa, Bielsko Biala, Poland) *Technika Lotnicza i Astronautyczna*, vol 29, Apr 1975, p 25-27 In Polish

**A75-31864** An exact calculation of the inviscid flow field on the lower surface of Nonweiler waveriders (Eine exakte Berechnung des reibungsfreien Strömungsfeldes an der Unterseite von Nonweiler-Wellenreitern) U Ganzer (Berlin, Technische Universität, Berlin, West Germany) *Zeitschrift für Flugwissenschaften*, vol 23, Apr 1975, p 109-116 7 refs In German

A method of calculation is presented for the flow conditions on the underside of a caret wing at freestream Mach numbers lower than the design Mach number. The method leads to an exact determination of the supposedly inviscid flow, provided that the compression shock is adjacent to the leading edges of the Nonweiler wing S J M

**A75-31865** Problems of structural identification - Partial survey of ground and flight vibration test methods (Probleme der Strukturidentifikation - Teilübersicht über Stand- und Flugschwingungsversuchsverfahren) H G Natke (Vereinigte Flugtechnische Werke - Fokker GmbH, Bremen, West Germany) *Zeitschrift für Flugwissenschaften*, vol 23, Apr 1975, p 116-125 33 refs In German

Experimental identification methods in the field of ground and flight vibration testing are presented and defined. It is emphasized that theoretical system analysis and empirical identification are based on theoretical and experimental models which must in turn be adapted to comparison to each other. This comparison often yields corrections in the theoretical system. Individual problems involved in the different means of structural identification are enumerated, and a classification system is discussed. Results of a decision analysis by Kepner and Tregoe concerning the choice of ground vibration test procedures on the basis of prescribed parameters are considered S J M

**A75-31867** Design of flight controllers with the help of modern system theory (Auslegung von Flugreglern mit Hilfe moderner Systemtheorie) G Schanzer (Bodenseewerk Geratetechnik GmbH, Überlingen, West Germany) (*Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 7th, Kiel, West Germany, Sept 17-19, 1974*) *Zeitschrift für Flugwissenschaften*, vol 23, Apr 1975, p 129-137 16 refs In German

A new flight controller concept has been developed for the task of improving the accuracy of flight path and aerodynamic flow state maintenance, particularly during bad weather. Using this flight controller design as an example, problems resulting from the application of modern system theory are discussed. Emphasis is placed on the economical realization of complete state vector feedback and on the choice of suitable quality criteria. The flight control system chosen is based on limited state vector feedback, superimposed quasistationary open-loop control, and parameter-insensitive observation S J M

**A75-31875 #** About the measurements of steady and unsteady aerodynamic forces on an airfoil section with a Mach-Zehnder

interferometer. Y Yamaguchi and M Iwasaki *Kyushu University, Technology Reports*, vol 47, Dec 1974, p 793-798 7 refs In Japanese

**A75-31878 #** **Solution of a model problem in flow around a porous cone (Rozv'iazannia model'noi zadachi pro obtikannia poristogo konusa)** A M Antonov and O V Khoroshilov (Kiev's'kii Derzhavnyi Universitet, Kiev, Ukrainian SSR) *Akademiia Nauk Ukrain's'koi RSR, Dopovidi, Seriya A - Fiziko-Matematichni ta Tekhnichni Nauki*, Feb 1975, p 129-132 6 refs In Ukrainian

The present work gives an approximate solution to the problem of the axisymmetric, supersonic flow around a thin, porous cone, where a gas is blown through the cone surface at a constant rate. It is assumed that the energy of the blown gas is sufficient to push aside the boundary layer and that the physical properties of the two gases are identical. The flow field is determined on the basis of a linear theory. Error analysis shows that the method is sufficiently accurate for engineering purposes if the Mach number of the undisturbed flow does not exceed 3. P T H

**A75-31991** **Symposium on the Application of Digital Avionic Systems in Aircraft, London, England, December 12, 1974, Proceedings.** Symposium sponsored by the Royal Aeronautical Society and Institution of Electrical Engineers. London, Royal Aeronautical Society, 1974 98 p

An introduction to digital avionic systems is provided along with a military view point regarding software maintenance. Attention is given to high integrity flight control systems, the impact of digital technology on inertial navigation, an aircraft manufacturer's experience, the use of digital computers in military aircraft, and an airline's experience with digital systems. Future developments in the area of airborne digital systems are also considered. G R

**A75-31992 #** **An introduction to digital avionic systems.** G E Roberts (Royal Aircraft Establishment, Farnborough, Hants, England) In *Symposium on the Application of Digital Avionic Systems in Aircraft, London, England, December 12, 1974, Proceedings*. London, Royal Aeronautical Society, 1974 5 p

The requirements for automatic data processing in avionics are considered, taking into account the early development of analog technology for the transmission, processing, and display of data. Advances in digital technology made an airborne application of digital systems technically feasible by the late fifties. The advantages of digital systems in comparison to analog systems are discussed along with the introduction of digital techniques into civil and military avionics. Approaches were found to overcome certain difficulties related to data transmission, data display, and control switching. G R

**A75-31993 #** **High integrity flight control systems.** E S Eccles (Smiths Industries, Ltd, Wembley, Middx, England) In *Symposium on the Application of Digital Avionic Systems in Aircraft, London, England, December 12, 1974, Proceedings*. London, Royal Aeronautical Society, 1974 14 p

A high integrity system is one in which the uncertainties in expectation of its behavior have been reduced to very low levels. Questions of system testing are considered along with aspects of reliability and performance tolerance. The advantages of a use of digital techniques in high integrity systems are examined. Attention is given to in-situ testing, fault diagnosis and check-out, problems of electromagnetic interference, software and programming, system validation, and aspects of context dependency. G R

**A75-31995 #** **An aircraft manufacturer's experience.** H Latham (Hawker Siddeley Aviation, Ltd, Manchester, England) In *Symposium on the Application of Digital Avionic Systems in Aircraft, London, England, December 12, 1974, Proceedings*. London, Royal Aeronautical Society, 1974 21 p

A description is given of the development of the avionics system for the HS 801 aircraft by a British aerospace company. The development program was carried out in 6 stages covering bench, rig, and aircraft trials, during a 4-1/2 year period. Questions of development philosophy are discussed along with timescale constraints and aspects of software development. A system outline is presented, giving attention to equipment, system functions, the interface unit, displays, controls panels, recorder functions, the digital junction box, and the programs. Other topics considered are related to development problems and aspects of reliability and maintainability. G R

**A75-31996 #** **The use of digital computers in military aircraft - A test pilot's viewpoint.** J J Cockburn (British Aircraft Corp., Ltd, Warton, England) In *Symposium on the Application of Digital Avionic Systems in Aircraft, London, England, December 12, 1974, Proceedings*. London, Royal Aeronautical Society, 1974 8 p

A significant enhancement of system efficiency has been obtained by the employment of digital computers in navigation and weapon aiming systems. The increase in potential of the Jaguar over the Hunter is considered as an indication of the effect of a good computer based weapon system. Proposals are made for an even wider utilization of the computer. Applications of the computer in guidance and control systems are also discussed, taking into account fail safe systems, autostabilizer problems, automatic limitation monitoring, and an approach of spin prevention. G R

**A75-31997 #** **An airline's experience with digital systems.** D A Meredith (British Airways Board, London, England) In *Symposium on the Application of Digital Avionic Systems in Aircraft, London, England, December 12, 1974, Proceedings*. London, Royal Aeronautical Society, 1974 12 p

Experience obtained on the Boeing 747 aircraft with two digital systems is discussed. One of the systems is the Multiplex System which provides passenger entertainment and passenger service facilities. The second system, the Inertial Navigation System, was developed as the result of the need for self contained guidance. The Boeing 747 is fitted with three Inertial Navigation Systems. Each system consists of four units, including the inertial navigation unit, the control display unit, the mode selector unit, and the battery. The heart of the inertial navigation unit is the digital computer. G R

**A75-31998 #** **Software maintenance - A military view point.** J D Edwards (RAF, London, England) In *Symposium on the Application of Digital Avionic Systems in Aircraft, London, England, December 12, 1974, Proceedings*. London, Royal Aeronautical Society, 1974 7 p

The software maintenance aspects of operational real-time avionic computer systems are considered. The maintenance of software involves two types of operations. Operations of the first type are related to the diagnosis and the rectification of software faults. Operations of the second type are concerned with the design and production of alterations and additions to the software to meet new requirements. Attention is given to questions of software procurement, software content, maintenance preparations, the control organization, working procedures, and the execution of a software change. G R

**A75-31999 #** A look ahead from a decade of airborne digital fur internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol. 11, no 1, 1975, p 8-18 In German

The characteristics of the aircraft control process are examined, taking into account the function of the pilot in a closed-loop system. The control of lateral motion during the landing maneuver is considered along with the principles of semiautomatic control of the flight in accordance with the prescribed flight path. Attention is also given to the design principles of automatic systems, the derivation of the relations concerning the control of the aircraft in the horizontal plane, and details of aircraft control during the approach. G.R

**A75-32023 #** A brief account of the progress of turbine disk materials for aircraft jet engines C-T Kuo, Y-H. Chu, and C-H Shih. *Acta Metallurgica Sinica*, vol 10, Oct 1974, p 74-98 118 refs In Chinese

Various heat resistant alloys are considered as materials for turbine wheels of jet aircraft engines. The present state of the art and the developmental trend of such materials are reviewed with special emphasis on martensitic and austenitic stainless steels, nimonic and incoloy alloys, and intermetallics. Heat treatment techniques for the improvement of fatigue life are also reviewed. C.K.T

**A75-32042 #** Influence of a wake on the flow in an annular jet (O vlianii putnogo potoka na techenie v kol'tsevoi strue). A.I. Shvets. *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki*, Nov-Dec 1974, p 74-79 12 refs In Russian

The influence of the Mach number of a wake flow behind a cylindrical model with a cone-shaped nose on an annular jet expelled into the wake is studied in a wind tunnel. It is shown that at transonic velocities of the wake flow, the flow pattern with an open base region changes to one with a closed base region, and that this change is accompanied by a decrease in the pressure pulsation level. V.P.

**A75-32080** Aerodynamics. L.J. Clancy (Bradford, University, Bradford, England). New York, Halsted Press, 1975 627 p \$24.75

The characteristics of the atmosphere are considered along with units and dimensions, Bernoulli's theorem, the fundamentals of air flow, the characteristics of low-speed aerofoils, high-lift devices, incompressible potential flow, low-speed aerofoil and wing theory, viscous flow and boundary layers, compressible flow, high-speed aerofoils, and compressible potential flow theory. Attention is also given to experimental methods, elementary mechanics of flight, aircraft performance, aircraft stability and control, and questions of metrication. The elementary theory of propellers is discussed, taking into account the geometry of the propeller, airscrew coefficients, the Rankine-Froude momentum theory of propulsion, slipstream velocity, blade element theory, rotational inflow and outflow factors, and the performance of a blade element. G.R.

**A75-32081** The role of technology in commercial aircraft policy formulation, Proceedings of the Conference, Bethesda, Md., December 2-4, 1974. Conference sponsored by the American Institute of Aeronautics and Astronautics and National Science Foundation, NSF Grant No. ST-42974. Edited by J. Grey (American Institute of Aeronautics and Astronautics, Inc., New York, N.Y.). New York, American Institute of Aeronautics and Astronautics, Inc., 1975 60 p.

An attempt is made to provide objective information on the role of technology in federal policy formulation for commercial aircraft, with particular emphasis on exports. Viewpoints from science, finance, industry, and airline engineering are presented, working

group reports discuss technology, management, and RT & D factors as well as means of strengthening the technology base. Recommendations include federal backing of a strong RT & D program, unrestricted foreign sale of currently available commercial equipment, free dissemination of data and results generated by basic research, implementation by industry of screening processes to safeguard critical technology in foreign licensing and joint-venture agreements, and federal support of commercial aircraft exports in the increasingly competitive world market. S.J.M.

**A75-32101 #** Solving an aircraft routing model for long haul carriers. R.J. Richardson (American Airlines, Inc., New York, N.Y.). *Operations Research Society of America and Institute of Management Sciences, National Meeting, Chicago, Ill., Apr 30-May 2, 1975, Paper 40* p 24 refs. U.S. Department of Transportation Contract No. PA-11-0012.

An optimization approach is developed for the route construction process of an airline operating in long haul markets. The problem is to determine the sequence of stops for each aircraft from a main base through a network of cities returning to the original base. A mixed integer linear programming model is formulated to maximize the profit derived from each routing. The special structure of the mixed integer model is solved by an application of Benders' decomposition method. The procedure partitions the model into two programs which are solved in a finitely convergent, iterative process. Various improvements of the algorithm for this special problem are proposed, and their computational efficiency examined. Test results are presented. (Author)

**A75-32210 #** Formation of swirling jets expelled from annular nozzles (K voprosu o formirovani zakruchennykh strui, vytekaiushchikh iz kol'tsevykh sopel). E.M. Smirnov (Leningradskii Politehnicheskii Institut, Leningrad, USSR). *Inzhenerno-Fizicheskii Zhurnal*, vol 28, Apr 1975, p 643-652 7 refs In Russian.

The influence of the flow parameters at the nozzle exit section on the flow characteristics and the shape of a swirling jet is analyzed, assuming that the jet is expelled from a relatively narrow annulus and that it propagates in a space bounded by a wall normal to the jet. An equation is derived for calculating the position of the lines of maximum longitudinal velocities in an annular jet. V.P.

**A75-32298 #** Study of detached regimes in profile arrays (K issledovaniu otryvnykh rezhimov v reshetkakh profilei). S.M. Belotserkovskii, V.V. Guliaev, and M.I. Nisht. *Akademiia Nauk SSSR, Doklady*, vol 221, Mar 21, 1975, p 555-558 6 refs In Russian.

Results of computer-aided numerical calculations of the flow around thin profiles are presented for two types of profiles: a plate with nose section and a simple plate. Profile arrays with different values for the relative step and angle of geometric stagger were studied. The characteristics of detached flows forming immediately behind all surfaces of the array were studied for various angles of attack. The effect of geometric parameters and load state on the dynamics of detachment was investigated, and three critical flow regimes were discerned. Smooth flow takes place with unloaded arrays when in the initial state the intensity of combined vortices is equal to zero. Stable, nearly stationary detachment is observed in loaded arrays with small values of angle of geometric stagger and large relative step. Traveling detachment is obtained in loaded arrays with large angle of geometric stagger and small relative step. P.T.H.

**A75-32323** Helicopters - The changing scene / J.D. North Memorial Lecture/. J.P. Jones (Westlands Helicopter, Ltd., Yeovil, Somerset, England). *Aeronautical Journal*, vol 79, Apr 1975, p 147-155.

Current technical limitations on the helicopter and the advantages that could accrue in the technical domain if a supersonic rotor were developed. Balancing out rolling torque due to airspeed



differential over advancing and retreating rotors and the existence of a critical rotation speed are emphasized. In particular, preservation of the integral character of propulsive, lift, and maneuvering components in the helicopter is advised. Use of the supersonic rotor (SSR), if perfected, could increase lift, decrease cyclic pitch requirements, and increase forward speed from the present 200 knots to 350 knots. S J M

**A75-32324** 'Time is energy' /Henson and Stringfellow Memorial Lecture/. J T Stamper (Hawker Siddeley Aviation, Ltd, Kingston-upon-Thames, Surrey, England) *Aeronautical Journal*, vol 79, Apr 1975, p 169-178

Various means of reducing total journey time, particularly by the use of VTOL aircraft and by the elimination of end-time delays, are considered. If end-time delays could be reduced, cruise speed could be lowered, with a concomitant decrease in energy consumption. From another point of view, it is stressed that time saved is energy spent. Lower CTOL cruise speeds would result in a substantial increase in energy efficiency at only a small journey time penalty. S J M

**A75-32325** On the stability of a dirigible body. P C Rath and S M Sharma (Institute of Armament Technology, Pune, India) *Aeronautical Journal*, vol 79, Apr 1975, p 179-181

In the present work a suitable majorant function for the static stability condition  $J_{sub M}$  is derived. For this purpose, the aerodynamic coefficients are assumed to be slowly ranging functions of the path length, as is usually stipulated. The stability problem is solved using certain known results in the oscillation theory of differential equations. The oscillatory stability of plane-yawing motion and stability by the WBJK approximation are treated. S J M

**A75-32334** # On the flow around an air inlet (Sur l'écoulement autour d'une prise d'air). H Werle and M Gallon (ONERA, Châtillon sous Bagneux, Hauts-de-Seine, France) *La Recherche Aéronautique*, Mar-Apr 1975, p 81-92. 23 refs. In French.

The present hydraulic test tunnel study was conducted to determine the external and internal flow separations capable of affecting the performance of air inlets. The results obtained are essentially qualitative, but they draw attention to certain pitfalls common in flow experiment procedures. For each intake geometry, the flow configuration, influence of geometric and aerodynamic parameters, and efficiency of the various means implemented to avoid or minimize separations were ascertained. S J M

**A75-32336** # Characterization of the sound field of a hot jet from its infrared emission (Caractérisation du champ sonore d'un jet chaud à partir de son émission infrarouge). J F de Bellevil (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, Compiègne, Université de Technologie, Compiègne, France) *La Recherche Aéronautique*, Mar-Apr 1975, p 105-115. 30 refs. In French.

The paper shows how the turbulence of a hot flow, whether subcritical or supercritical, can be characterized from its own infrared emission. After a description of the measurement, calibration and signal processing techniques, some examples of application are discussed. The use of existing theoretical models permits an acoustic interpretation of the measurements, after a numerical treatment of the results, this is compared with far-field acoustic measurements, carried out in an anechoic chamber, and is also discussed through correlations between the flow and the near and far sound field. (Author)

**A75-32350** EMUX, the B-1's hidden system. W R Fitzgerald (Harris-Intertype Corp, Melbourne, Fla.) and J W Canto (Rockwell International Corp, El Segundo, Calif) *Signal*, vol 29, May-June 1975, p 57-60, 62

The electrical/electronic multiplexing (EMUX) system used in the B-1 includes a number of remote input and output terminals and a master control unit. The EMUX system controls the B-1's major subsystems. The EMUX sequence of operations is considered along with the operational characteristics of the system. Time-division multiplexing is used in the EMUX system. The master control unit monitors, controls, processes, and distributes data from input to output over the time-shared transmission line. The largest of three memories in the master control unit can store as many as 240,000 bits. G R

## STAR ENTRIES

**N75-21219#** Advisory Group for Aerospace Research and Development Paris (France)

### TAKE-OFF AND LANDING

Jan 1975 300 p refs Presented at 44th Meeting of the Flight Mech Panel of AGARD, Edinburgh 1-4 Apr 1974 (AGARD-CP-160) Avail NTIS HC \$8 75

The proceedings of a conference on aircraft takeoff and landing are presented The subjects discussed include the following (1) aircraft design optimization (2) energy management (3) aircraft stability and control characteristics, (4) aircraft guidance using ground based and airborne equipment, and (5) operational aspects of approach control with short takeoff aircraft

**N75-21220\*** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

### HIGH-LIFT AERODYNAMICS TRENDS, TRADES, AND OPTIONS

Richard J Margason and Harry L Morgan, Jr /n AGARD Take-off and Landing Jan 1975 11 p refs

The trend toward the utilization of higher maximum lift coefficient with increased aircraft size and cruise velocities is discussed The impact of this trend on the need for tradeoffs between cruise performance and takeoff, climb and landing performance is examined Theoretical methods for the analysis of the two-dimensional characteristics of flap systems are described and compared with experimental data Four powered-lift concepts are described to outline some of the options currently being developed Two jet-flap theories are described which provide analytical methods for estimation of the three-dimensional aerodynamic high-lift performance characteristics of powered lift systems

Author

**N75-21221\*** Messerschmitt-Boelkow-Blohm G m b H , Munich (West Germany)

### COMPATIBILITY OF TAKE-OFF AND LANDING WITH MISSION AND MANOEUVRE PERFORMANCE REQUIREMENTS FOR FIGHTER AIRCRAFT

Dieter Reich and Josef Wimbauer /n AGARD Take-off and Landing Jan 1975 7 p refs

By means of an aircraft synthesis program, the effect of engine cycle, thrust to weight ratio and wing parameter combination on field and flight performance has been investigated For three different engine/intake configurations, thrust to weight ratio and wing loading were varied Each combination represents an aircraft designed to meet a specified mission radius Using different lift systems and ground deceleration devices, the conditions are shown under which a matching of flight and field performance is economically feasible

Author

**N75-21222** Aerospatiale Usines de Toulouse (France)

### GENERAL CRITERIA FOR THE DEFINITION OF TAKE-OFF AND LANDING OF AN AIRCRAFT WITH NONLIMITED LIFT [CRITERES GENERAUX POUR LA DEFINITION AU DECOLLAGE ET A L'ATTERRISSAGE D'UN AVION NON LIMITE EN PORTANCE]

C Pelagatti and T Markham (British Aircraft Corp., Bristol, England) /n AGARD Take-off and Landing Jan 1975 11 p In FRENCH

The performance of a slender wing aircraft configuration with unlimited lift was studied A description is given of the approach process, aerodynamic characteristics, and certification regulations The optimization of characteristics based on speed was developed after considering examples from the Concorde

Transl by E H W

### N75-21223\* Boeing Commercial Airplane Co Seattle Wash TERMINAL AREA CONSIDERATIONS FOR AN ADVANCED CTOL TRANSPORT AIRCRAFT

Mark B Sussman /n AGARD Take-off and Landing Jan 1975 14 p refs (Contract NAS1-12018)

Projected future conditions at large urban airports were used to identify design objectives for a long-haul, advanced transport airplane introduced for operation in the mid-1980s Operating constraints associated with airport congestion and aircraft noise and emissions were of central interest In addition, some of the interaction of these constraints with aircraft fuel usage were identified The study allowed for advanced aircraft design features consistent with the future operating period A baseline 200 passenger airplane design was modified to comply with design requirements imposed by terminal area constraints Specific design changes included (1) modification of engine arrangement wing planform (2) drag and spoiler surfaces (3) secondary power systems (4) brake and landing gear characteristics and (5) the aircraft avionics These changes based on exploratory design estimates and allowing for technology advance were judged to enable the airplane to reduce wake turbulence, handle steeper descent paths with fewer limitation due to engine characteristics, reduce runway occupancy times, improve community noise contours, and reduce the total engine emittants deposited in the terminal area The penalties to airplane performance and operating cost associated with improving the terminal area characteristics of the airplane were assessed Finally key research problems equiring solution in order to validate the assumed advanced airplane technology were identified

Author

### N75-21224 Service Technique de l'Aeronautique, Paris (France) BRAKING PERFORMANCES

Georges Leblanc /n AGARD Take-off and Landing Jan 1975 17 p In FRENCH, ENGLISH summary

During Landing or aborted take-off, the braking distances are depending on the speed allowed by high lift devices and on the Kinetic energy which must be absorbed by the braking systems according to the available friction coefficient of tire runway Studies on this last point have not yet been so extensive as aerodynamic studies Beside obvious interest for performances, it is necessary to know how to determine the safety margins which have to be taken on braking distances according to actual conditions of the runway For the prediction of braking distance a comprehensive scheme of friction phenomena on wet runway according the three zone's GROUCH model is proposed The test results obtained with CARAVELLE Aircraft confirm that the proposed model is correct and that it can give a satisfactory prediction of the braking distance

Author

**N75-21225** Air Force Flight Dynamics Lab , Wright-Patterson AFB, Ohio

### TRADEOFF PARAMETERS OF ALTERNATIVE TAKEOFF AND LANDING AIDS

Kennerly H Digges /n AGARD Take-off and Landing Jan 1975 18 p refs

The various aids for reducing takeoff and landing distance are discussed The launch aids include rocket assist, catapults and powered lift The landing aids include reversed turbojet thrust, parachutes and wheel brakes New technology aimed at reducing the weight or increasing the performance of landing aids is indicated The ways in which stopping distance is affected by variations in parameters such as lift coefficient drag coefficient, reversed thrust, landing velocity and runway friction coefficient are shown

Author

**N75-21226** Royal Aircraft Establishment, Bedford (England)  
**A TECHNIQUE FOR ANALYSING THE LANDING MANOEUVRE**

R F A Keating /In AGARD Take-off and Landing Jan 1975 12 p refs

Studies of steep gradient aviation have highlighted the need to find the underlying piloting strategy of landings. A graphic presentation of landing records is put forward which, it is hoped, will assist in the solution to this problem. By expressing the pilot's longitudinal control activity as equivalent speed and climb rate demands, it is possible to plot simultaneously the aircraft motion and the control strategy against the performance chart as a reference grid. By suitable choice of axis scaling, the aircraft's response to simple control input traces out simple geometric patterns such as circular arcs. Examples are given of flight data, principally of the HS 125 in normal, steep and two segment approaches. Power margins and target speeds are discussed for these examples. Author

**N75-21227\*** National Aeronautics and Space Administration  
 Ames Research Center, Moffett Field, Calif

**STABILITY AND CONTROL HARMONY IN APPROACH AND LANDING**

Seth B Anderson /In AGARD Take-off and Landing Jan 1975 8 p refs

A review of the factors which affect stability and control harmony in approach and landing is made to obtain a clearer understanding of the proper relationship, the trade-offs involved, and to show how limits in stability and control harmony are established for advanced aircraft. Factors which influence stability and control harmony include the longitudinal short period response of the aircraft and the level of several pitch control characteristics including control power, control sensitivity, and control feel. At low stability levels for advanced aircraft, less conventional control techniques such as DLC are needed to improve harmony and some form of stability augmentation must be provided to improve precession of flight path control and reduce pilot work load. Author

**N75-21228** National Aeronautical Establishment, Ottawa (Ontario)

**THE INFLUENCE OF STOL LONGITUDINAL HANDLING QUALITIES OF PILOTS' OPINIONS**

K-H Doetsch, Jr /In AGARD Take-off and Landing Jan 1975 17 p refs  
 (Contract F33615-71-C-1722)

Consideration is given to some of the factors which distinguish the longitudinal handling qualities of STOL aircraft from those of the CTOL class and to the influence of these differences on pilot's opinions. The effects of wind, wind-shear, trim speed, thrust vector inclination, speed coupling, pitch characteristics and of using different control technique options on flight-path control are discussed briefly. In-flight evaluations of variations in some of these parameters provided a basis for assessing their relative importance to the pilot when he was faced with a demanding instrument approach task. Control of pitch proved to be central to the overall flight-path control task and the more easily and precisely the pilot could modulate pitch, the more adverse the speed coupling effects he was prepared to tolerate. For the typical unaugmented stability characteristics of the STOL class of aircraft exhibiting small modal separation, the handling qualities were governed by the overall responses to control and disturbance inputs rather than by the location of individual roots of the characteristic equation. Author

**N75-21229** Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost

**LOW-SPEED STABILITY AND CONTROL CHARACTERISTICS OF TRANSPORT AIRCRAFT WITH PARTICULAR REFERENCE TO TAILPLANE DESIGN**

E Obert /In AGARD Take-off and Landing Jan 1975 16 p

For modern transport aircraft generally emphasis is put on operational flexibility. This means among other things that the ability is required to operate at low take-off and landing speeds

under a wide range of loading conditions. Consequently the operational envelope of the aircraft covers a large range of lift coefficients and CG positions. The ensuing requirements for the design of horizontal tail surfaces and elevators are difficult to fulfil. Some of the low-speed tailplane and elevator problems are considered. Particular reference is made to the possibility of tailplane stall. Some related experience obtained in the design and flight testing of the Fokker-VFW F-27 and F-28 is discussed. Author

**N75-21230** Vereinigte Flugtechnische Werke-Fokker G m b H, Bremen (West Germany)

**SOME LOW SPEED ASPECTS OF THE TWIN-ENGINE SHORT HAUL AIRCRAFT VFW 614**

Hartmut Griem, Juergen Barche, Hans J. Beisenherz, and Guenther Krenz /In AGARD Take-off and Landing Jan 1975 19 p refs

The flight characteristics of the VFW 614, short haul aircraft, are discussed. The low speed aspects of the aircraft are analyzed with respect to: (1) wing stall aerodynamics, (2) tail stall aerodynamics, (3) longitudinal control, and (4) lateral/directional control. The aircraft design criteria are identified. The dimensions and configurations of the aircraft controls are tabulated. Flight test results are summarized. Author

**N75-21231** British Aircraft Corp., Weybridge (England)  
 Commercial Aircraft Div

**DIRECT LIFT CONTROL APPLICATIONS TO TRANSPORT AIRCRAFT: A UK VIEWPOINT**

M R Smith /In AGARD Take-off and Landing Jan 1975 10 p refs

The longitudinal controllability of large conventional transport aircraft during the approach and landing flight phases and of conventional high lift 'STOL' aircraft during short landings, is discussed. The advantage of a direct lift control system (DLC) is indicated, and a practical design, using wing spoilers, is described, with its disadvantages. Theoretical and flight simulator investigations on the VC10 aircraft, and the BAC 1-11 aircraft are described, together with investigations of similar systems for improving the automatic landing of current British jet aircraft. Some recent investigations on a DLC application to a STOL aircraft are noted. It is concluded that DLC applications can improve controllability and performance for most transport aircraft. A more detailed study is required for each application before its true value can be assessed, even for large transport aircraft. Application of DLC to conventional lift STOL aircraft looks attractive for achieving satisfactory flare performance. Author

**N75-21232** Messerschmitt-Boelkow-Blohm G m b H, Munich (West Germany)

**INVESTIGATIONS ON DIRECT FORCE CONTROL FOR CCV AIRCRAFT DURING APPROACH AND LANDING**

Wolfgang J. Kubbat /In AGARD Take-off and Landing Jan 1975 11 p

The aerodynamic characteristics of control configured vehicles (CCV) with direct force controls (DFC) are discussed. The following aspects are considered: (1) the influence of the controls on the natural stability, (2) the influence of DFC on the controllability of the aircraft, (3) the integration of the DFC with the control system in CCV designs, (4) the behavior of CCV aircraft with DFC during approach and landing, and (5) the relationship of the results presented in the basic CCV concept. Author

**N75-21233** Yingling (George L.), Dayton, Ohio  
**GUIDANCE PHILOSOPHY FOR MILITARY INSTRUMENT LANDING**

George L. Yingling /In AGARD Take-off and Landing Jan 1975 13 p refs

Instrument landing guidance philosophy for military aircraft is affected by the type of operation, the nature of the environment, the kind of aircraft involved and system dynamics considerations. Guidance philosophy and requirements are inseparable from control dynamics and tradeoffs exist between the two in arriving at an optimum solution for particular cases. In some countries, compatibility and interoperability with the civil system is

considered important if not essential. The National Microwave Landing System program in the USA is of great interest internationally, and the USA Department of Defense is supporting, at present, the goal of a common civil/military system. Representative unclassified operational requirements are reviewed as a lead to discussing the various factors having an impact on choice of guidance philosophy. The single most important consideration is the choice of technique to overcome landing guidance system multipath effects. The choice of technique must satisfy the many system dynamic considerations and present field test programs must provide clear and valid engineering data upon which to base a decision. A system solution to a hypothetical but representative military situation is presented for discussion purposes. In addition a requirement for an all-airborne, self-contained landing system is discussed. Author

**N75-21234** Royal Aircraft Establishment, Bedford (England)  
**THE IMPROVEMENT OF VISUAL AIDS FOR APPROACH AND LANDING**

A J Smith and D Johnson. In AGARD Take-off and Landing Jan 1975 15 p refs

The effect of fog on the operational capability of runway lights is discussed. A study on the variations of fog gradients with altitude is reported. Improvements in approach and runway lighting to overcome the attenuation caused by fog are described. The characteristics of a precision approach path indicator for steep gradient and two-segment approaches are analyzed. The author states that landings made using the improved equipment have been achieved with a touchdown scatter that is much smaller than is normally achieved. Author

**N75-21235** National Aerospace Lab., Amsterdam (Netherlands)  
**FLIGHT TESTS WITH A SIMPLE HEAD-UP DISPLAY USED AS A VISUAL APPROACH AID**

G L Lamers. In AGARD Take-off and Landing Jan 1975 11 p refs

A simple head-up display (HUD), giving only glide path information with a depressed horizon bar, has been tested as an approach aid in visual flight conditions. An important improvement was observed in the accuracy of the glide path performance when approaches with the use of a HUD are compared with visual approaches without an approach aid. Using the HUD decreased the standard deviations of height by a factor of 2 to 4 depending on distance from the runway. From this limited series of tests no significant differences in other flight parameters could be demonstrated. The subject pilots indicated a preference for use of the HUD during visual approaches, especially in night conditions. Author

**N75-21236** Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France)

**ALL-WEATHER LANDING SYSTEM FOR MERCURY [LE SYSTEME D'ATTERRISSAGE TOUS TEMPS DU MERCURE]**

Armand Pile. In AGARD Take-off and Landing Jan 1975 11 p In FRENCH

Principle characteristics of the AIR-INTER version of an all-weather landing system with collimators for Mercury are outlined. Transl by E H W

**N75-21237** Office National d'Etudes et de Recherches Aeronautiques, Paris (France)  
**REQUIRED PILOT CUES AND DISPLAYS FOR TAKEOFF AND LANDING**

Jean-Claude Wanner. In AGARD Take-off and Landing Jan 1975 14 p In FRENCH, ENGLISH summary

A model of pilot behavior during the takeoff and landing phases of flight was constructed. The model was used to determine the necessary cues and in turn the parameters which have to be displayed in order to minimize the pilot work load and improve flight safety. A future cockpit display was designed, based on the display parameters. The main part of the system is a head-up display presenting the ground track of the air velocity vector and the total climb angle. With these two parameters the pilot can directly control the airpath, knowing exactly the necessary

rating of the engines and observing a correct safety margin for the angle of attack. Author

**N75-21238** Ministry of Transport, Ottawa (Ontario)  
**SOME DHC-6 TWIN OTTER APPROACH AND LANDING EXPERIENCE IN A STOL SYSTEM**

Richard P Bentham. In AGARD Take-off and Landing Jan 1975 11 p

The Canadian Government's decision to introduce a STOL demonstration service revealed a need for practical data and flight experience to assist in aircraft approval and development of safe operational procedures. From 1971 to 1973 a series of flight tests concerned with the steep approach and landing task were carried out, initially in a DHC-6-100 Twin Otter and later in a DHC-6-300S. Approach angles of 6 deg, 7 deg, and 8 deg were assessed in terms of pilot work load and aircraft touchdown and landing distances. Other relevant factors peculiar to the steep approach and landing task were investigated including transition from en-route guidance to approach guidance, crew co-ordination, night operation, missed approach and engine out missed approach, and approach turbulence and wind shear. Community noise sensitivity was closely monitored. The flight test program resulted in some modifications to the production aircraft, the development of approach and landing operating procedures and the definition of some potential problem areas. Author

**N75-21239** Air Force Flight Test Center, Edwards AFB, Calif  
**LOW POWER APPROACH**

B Lyle Schofield. In AGARD Take-off and Landing Jan 1975 11 p refs

Discussions are presented on current final approach-to-landing procedures along with the relationship of conventional approach speeds to the lift to drag (L/D) relationships of aircraft. The characteristics of L/D relationships are discussed in view of the landing approach maneuver, identifying the potential advantages of operating on the front side of the L/D curve. Flight experience of low L/D, idle power approaches using the front side of the L/D curve are reviewed in light of the piloting task. The velocity convergence relationship for operating on the front side of the L/D curve are presented and the convergent characteristics for both transport and fighter aircraft are explored. Front side approach and landing performance for the KC-135A and T-38A aircraft are presented. Convair 990 touchdown dispersions from low L/D, idle approaches are presented. Other significant advantages of the low power, front side L/D landing approach are enumerated. Author

**N75-21240** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany)

**STEEP APPROACH FLIGHT TEST RESULTS OF A BUSINESS-TYPE AIRCRAFT WITH DIRECT LIFT CONTROL**

P G Hamel, K K Wilhelm, D H Hanke, and H H Lange. In AGARD Take-off and Landing Jan 1975 19 p refs

The trends in aircraft approach and landing procedures are such that increasingly noise abatement constraints impact on vehicle flying (handling) qualities. A ground-based flight simulator program and concurrently a flight test program were conducted using a MBB-HFB-320 Hansa Jet airplane which was retrofitted with an analogue fly-by-wire flap and thrust control system. The direct-lift control system was used for alleviating handling qualities problems during steep noise-abatement landing approaches. A variable direct lift control system was made feasible for optimization purposes by changing the gearing ratio of the electric flap-elevator interconnect. Facilitation in pilot's workload and improvements in flight path control were analyzed by statistical methods. Experiences gained by flight test results and noise measurements show that routine 2-segment noise-abatement approach paths can be introduced successfully when adequate path guidance, quick-response flight path corrections and minimum throttle activity are possible. Author

**N75-21241** Centre d'Essais en Vol, Bretigny-sur-Orge (France)  
**MODERN MEANS OF TRAJECTOGRAPHY [MOYENS MODERNES DE TRAJECTOGRAPHIE]**

Alain Tert /in AGARD Take-off and Landing Jan 1975 15 p  
In FRENCH

Various equipment and systems developed and utilized for take-off and landing trajectography of modern aircraft are examined The STRADA, LIDAR, and inertial navigation systems are covered, systems are designed to measure trajectories accurately and rapidly without error Transl by E H W

**N75-21243#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**SEMINARS: AN EFFECTIVE METHOD FOR DISSEMINATING ADVANCED EXPERIENCE**

I A Lev 6 Dec 1974 11 p Transl into ENGLISH from Nauch Tekhn Inform Ser 1, Organ i Metod Inform Raboty (USSR), no 2, Sep 1972 p 18-19

(AD-A002805, FTD-HT-23-635-75) Avail NTIS CSCL 01/3  
The translation discusses briefly the seminars at the Bykovskiy Aircraft-Maintenance Plant for the purpose of study and adaptation of the achievements made in science, technology and advanced industrial experience GRA

**N75-21244** Mississippi State Univ, State College  
**FEASIBILITY STUDY OF THE USE OF THE LK-10A GLIDER AS A POST STALL RESEARCH VEHICLE Ph D. Thesis**

Donald Thomas Ward 1974 200 p  
Avail Univ Microfilms Order No 75-4223

The feasibility of using a low cost sailplane for post-stall research and training is analyzed Post-stall characteristics of the test aircraft and instrumentation requirements for post-stall research in sailplanes are identified Post-stall operational constraints for gliders are qualitatively examined The aircraft was modified for safety and to provide quantitative measurements of post-stall parameters The post-stall characteristics of the aircraft were satisfactory for post-stall research and provide valuable experience for pilots training for post-stall tests Mildly oscillatory spin modes were observed The steep mode had an angle of attack of 35 deg, while the flatter spin mode had an angle of attack of 55 deg Aerodynamic controls were effective for recovery from either spins or post-stall gyrations The direct operating costs of the sailplane are an order of magnitude less than those of operational jet aircraft used to explore post-stall regime The structural and system simplicity of the sailplane allows modifications to be made economically The low cost, demonstrated safety, and broad spectrum of available post-stall motions suggest a significant post-stall research capability and a useful post-stall training potential for the sailplane

Dissert Abstr

**N75-21246** Texas Univ, Austin  
**APPLICATION OF A GRADIENT PROJECTION TECHNIQUE TO MINIMUM-WEIGHT DESIGN OF LIFTING SURFACES WITH AEROELASTIC AND STATIC CONSTRAINTS Ph D. Thesis**

Ibrahim Onur Erbug 1974 163 p  
Avail Univ Microfilms Order No 75-4358

A parameter optimization algorithm is developed based on the gradient projection concept The algorithm is applied to the aeroelastic optimization of a semi-infinite panel in supersonic flow and to the aeroelastic-stress optimization of a delta-wing in supersonic flow The total weight is taken as the objective function Constraints are placed on flutter speed and minimum thickness for the panel problem and on flutter speed, stress, and minimum thickness for the delta wing problem Different finite element combinations are studied for the panel problem Using six tapered elements across the span, the effect of damping on the optimum shape is investigated For the delta-wing problem a 3x3 grid of triangular bending elements is used The effect of constraints on the optimum shape is studied by optimizing the structure first using only flutter and thickness constraints, then using only stress and thickness constraints and finally using all three sets of constraints Total weight reductions of 47% to 63% are obtained depending on the combinations of constraints Dissert Abstr

**N75-21247\*#** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

**FLOW VISUALIZATION STUDY OF CLOSE-COUPLED CANARD WING AND STRAKE WING CONFIGURATION**  
Dennis D Miner and Blair B Gloss 3 Mar 1975 115 p refs  
(NASA-TM-X-72668) Avail NTIS HC \$5 25 CSCL 01A

The Langley 1/8-scale V/STOL model tunnel was used to qualitatively determine the flow fields associated with semi-span close coupled canard wing and strake wing models Small helium filled bubbles were injected upstream of the models to make the flow visible Photographs were taken over the angle-of-attack ranges of -10 deg to 40 deg Author

**N75-21248\*#** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

**LONGITUDINAL AERODYNAMICS OF A LOW-WING LIFT-FAN TRANSPORT INCLUDING HOVER CHARACTERISTICS IN AND OUT OF GROUND EFFECT**

Danny R Hoad (Army Air Mobility R and D Lab, Hampton Va) and Garl L Gentry, Jr Apr 1975 155 p refs

(NASA-TM-X-72670) Avail NTIS HC \$6 25 CSCL 01A

A wind-tunnel investigation was conducted in the Langley V/STOL tunnel to determine the longitudinal aerodynamic characteristics of a six-fan, tip-driven (remote) lift-fan VTOL transport throughout transition The large midspan lift-fan pods and cruise fans were removed to determine their influence on the stability and control of the configuration Data were obtained in the hovering mode for ranges of model height above ground The data are presented without analysis or discussion Author

**N75-21249\*#** National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

**WIND TUNNEL INVESTIGATION OF HELICOPTER-ROTOR WAKE EFFECTS ON THREE HELICOPTER FUSELAGE MODELS**

John C Wilson and Raymond E Mineck Washington Mar 1975 209 p refs

(NASA-TM-X-3185, L-9454) Avail NTIS HC \$7 25 CSCL 01A

The effects of rotor wake on helicopter fuselage aerodynamic characteristics were investigated in the Langley V/STOL tunnel Force, moment, and pressure data were obtained on three fuselage models at various combinations of windspeed, sideslip angle, and pitch angle The data show that the influence of rotor wake on the helicopter fuselage yawing moment imposes a significant additional thrust requirement on the tail rotor of a single-rotor helicopter at high sideslip angles Author

**N75-21250\*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

**COLD-AIR ANNULAR-CASCADE INVESTIGATION OF AERODYNAMIC PERFORMANCE OF CORE-ENGINE-COOLED TURBINE VANES 1 SOLID-VANE PERFORMANCE AND FACILITY DESCRIPTION**

Louis J Goldman and Kerry L McLallin Washington Apr 1975 25 p refs

(NASA-TM-X-3224, E-8214) Avail NTIS HC \$3 25 CSCL 01A

The aerodynamic performance of a solid (uncooled) version of a core engine cooled stator vane was experimentally determined in a full-annular cascade, where three-dimensional effects could be obtained The solid vane, which serves as a basis for comparison with subsequent cooled tests, was tested over a range of aftermixed critical velocity ratios of 0.57 to 0.90 Overall vane aftermixed efficiencies were obtained over this critical velocity ratio range and compared with results from a two-dimensional cascade The variation in vane efficiency and aftermixed flow conditions with circumferential and radial position were obtained and compared with design values Vane surface static-pressure distributions were also measured and compared with theoretical results Author

**N75-21251\*# Lockheed Aircraft Corp., Marietta, Ga  
HIGH REYNOLDS NUMBER TEST OF A NACA 651-213, a  
EQUALS 0.5 AIRFOIL AT TRANSONIC SPEEDS**

Kenneth P. Burdges, James A. Blackwell, Jr., and Gerald A. Pounds. Washington: NASA, Mar 1975. 164 p. refs. (Contract NAS1-12325)

(NASA-CR-2499) Avail NTIS HC \$6.25 CSCL 01A

Wind-Tunnel tests were conducted in the Lockheed-Georgia Company's compressible flow facility to determine the transonic two-dimensional aerodynamic characteristics of a NACA 65 sub 1-213 a = 0.50 airfoil. The results are correlated with data obtained in the NASA-Langley 8-foot transonic pressure tunnel and the NAE high Reynolds number 15x60-inch two-dimensional test facility. The tests were conducted over a Mach number range from 0.60 to 0.80 and an angle of attack range from -1 deg to 8 deg. Reynolds numbers, based on the airfoil chord, were varied. Author

**N75-21252# Rochester Applied Science Associates, Inc., N.Y.  
EFFECT OF WAKE ON THE PERFORMANCE AND STABILITY  
CHARACTERISTICS OF ADVANCED ROTOR SYSTEMS  
Final Report**

Keith W. Shipman. Sep 1974. 164 p. refs.

(Contract DAAJ02-73-C-0030, DA Proj 1F1-62204-AA-41)

(AD-A002671 RASA-74-03, USAAMRDL-TR-74-45) Avail NTIS CSCL 01/1

The performance parameters and stability and control derivatives for various rotor systems are considered using the wake-induced velocity distributions to compute the loading and responses of the rotor blades. The geometry of a self-deformed wake is used to compute influence coefficients which, when multiplied by the blade circulation loading, provide the distribution of the wake-induced velocities. The blade's loading and response are coupled together and iterations are carried out in the blade loads and response program until the two are compatible. Interactions of the wake with the airframe are not considered, and the flight conditions are limited to steady forward flight. GRA

**N75-21253# Martin Marietta Aerospace, Orlando, Fla  
AERODYNAMIC METHODOLOGY BODIES WITH TAILS  
AT ARBITRARY ROLL ANGLE Final Report, Jun. - Dec.  
1974**

John E. Fidler and Michael C. Bateman. Dec 1974. 77 p. refs. (Contract DAAH01-74-C-0621)

(AD-A003341, OR-3375-1) Avail NTIS CSCL 16/4

The construction and use of empirical methods for predicting aerodynamic characteristics of body/tail missile configurations are described. Methods are applicable to the case of combined angle of attack (up to 25 degrees) and roll (up to 90 degrees). Mach number range is 0.8 - 1.2. The methods deal with the separate components of the missile and with their mutual interactions. Comparisons between predicted and experimental data show generally good agreement. GRA

**N75-21254\*# National Aeronautics and Space Administration  
Ames Research Center, Moffett Field, Calif  
STOL TERMINAL AREA OPERATING SYSTEMS (AIRCRAFT  
AND ONBOARD AVIONICS, ATC, NAVIGATION AIDS)**

Clifford Burrous, Heinz Erzberger, Norman Johnson, and Frank Neuman. Nov 1974. 50 p. refs.

(NASA-TM-X-62403, A-5829) Avail NTIS HC \$3.75 CSCL 01B

Operational procedures and systems onboard the STOL aircraft which are required to enable the aircraft to perform acceptably in restricted airspace in all types of atmospheric conditions and weather are discussed. Results of simulation and flight investigations to establish operational criteria are presented. Author

**N75-21255\*# United Air Lines, Inc., Chicago, Ill  
OPERATIONAL FLIGHT EVALUATION OF THE TWO-  
SEGMENT APPROACH FOR USE IN AIRLINE SERVICE**

G. K. Schwind, J. A. Morrison, W. E. Nylan, and E. B. Anderson. Washington: NASA, Apr 1975. 65 p. refs. (Contract NAS2-7208)

(NASA-CR-2515) Avail NTIS HC \$4.25 CSCL 01B

United Airlines has developed and evaluated a two-segment noise abatement approach procedure for use on Boeing 727 aircraft in air carrier service. In a flight simulator, the two-segment approach was studied in detail and a profile and procedures were developed. Equipment adaptable to contemporary avionics and navigation systems was designed and manufactured by Collins Radio Company and was installed and evaluated in B-727-200 aircraft. The equipment, profile, and procedures were evaluated out of revenue service by pilots representing government agencies, airlines, airframe manufacturers, and professional pilot associations. A system was then placed into scheduled airline service for six months during which 555 two-segment approaches were flown at three airports by 55 airline pilots. The system was determined to be safe, easy to fly, and compatible with the airline operational environment. Author

**N75-21256\*# Bell Helicopter Co., Fort Worth, Tex  
CONCEPTUAL DESIGN STUDY OF 1985 COMMERCIAL TILT  
ROTOR TRANSPORTS. VOLUME 1. VTOL DESIGN  
SUMMARY Final Report**

J. A. Detore and K. W. Sambell. Washington: NASA, May 1975. 115 p. refs.

(Contract NAS2-8259)

(NASA-CR-2544, D312-099-002-Vol-1) Avail NTIS HC \$5.25 CSCL 01C

Aircraft were synthesized in the 21-, 45-, and 100-passenger categories. Technological factors were considered and the 45-passenger point design, designated the D312, was selected. Variants of the D312 having sideline noise levels in hover of + or - 5 PNdB were also studied. All three 45-passenger aircraft were analyzed for performance, weights, economics, handling qualities, noise footprints, aeroelastic stability and ride comfort. Results are presented. Author

**N75-21257 Ohio State Univ., Columbus  
CLASSIFICATION OF OBJECTS WITH COMPLEX GEOMET-  
RIC SHAPE BY MEANS OF LOW FREQUENCY ELECTRO-  
MAGNETIC RESPONSE Ph.D. Thesis**

Yau Tang Lin. 1974. 111 p.

Avail Univ Microfilms Order No 75-3125

A study of the effectiveness of low-frequency electromagnetic responses for identifying objects of complex shape is presented. The linear separability of a large variety of objects such as cubes, cylinders and aircraft were examined. An efficient computational method for modeling the scattering returns from an arbitrarily shaped object was developed. This technique was used to simulate the required radar returns from aircraft without resorting to time consuming and costly experimental measurements. Two classification algorithms, a linear discriminant and a nearest neighbor rule, were used to classify a set of four aircraft models. The results indicate that amplitude, phase and polarization each carries a substantial amount of target information. With the assumption of a priori knowledge of the target's approximate aspect angle, a reliable classification can be attained utilizing a rather small number of frequencies. Dissert Abstr

**N75-21265 Washington Univ., Seattle  
A NON-GAUSSIAN MODEL OF CONTINUOUS ATMOS-  
PHERIC TURBULENCE FOR USE IN AIRCRAFT DESIGN  
Ph.D. Thesis**

Paul Miller Reeves. 1974. 256 p.

Avail Univ Microfilms Order No 75-4040

The research is restricted to the modeling of regions of the atmosphere within which the disturbance to the aircraft is steady or continuous, and the assumptions of homogeneity and stationarity are justified. In order to simplify the discussion, the problem is further restricted to cases in which the distribution of gusts over the surface of the aircraft can be neglected. Thus the turbulence model discussed in this report consists of three independent, stationary stochastic processes which represent the vertical, lateral, and longitudinal gust components encountered by the aircraft as it moves through the gust field. The Gaussian model now in wide use is reviewed. A comparison of this model

with experimental data shows that it underestimates the number of high velocity gusts which occur in the atmosphere

Dissert Abstr

**N75-21266** Virginia Univ., Charlottesville  
**COMPUTER AIDED DESIGN OF AIRCRAFT STRUCTURES**  
**Ph D Thesis**

Gary Lee Giles 1974 308 p  
 Avail Univ Microfilms Order No 75-4682

Procedures developed for automated design of aircraft structures are presented in three stages description and identification of key aspects of the overall structural design process, descriptions of analytical design procedures developed to perform specific steps, and numerical results from two design systems, one for early preliminary design and another for later stages of preliminary design. The automated procedures are used to make design studies of a Mach 3 transport wing. The usefulness of the routines for automatic generation of analytical models and routines for graphic output of design information is illustrated. Design calculations are made using crude and refined structural models to assess the effects of different levels of modeling on numerical results and computational time. It is concluded that for an efficient design system procedures should be tailored to a particular phase of the design process and corresponding level of modeling, with the essential capability for transfer of data between levels included. Dissert Abstr

**N75-21267\*** Arde, Inc., Mahwah, N J  
**FABRICATION AND TESTING OF PRESTRESSED COMPOSITE ROTOR BLADE SPAR SPECIMENS** Final Report

David Gleich Oct 1974 113 p refs  
 (Contract NAS1-11594)  
 (NASA-CR-132611, ARDE-J/N-41004) Avail NTIS  
 HC \$5 25 CSCL 01C

Prestressed composite spar specimens were fabricated and evaluated by crack propagation and ballistic penetration tests. The crack propagation tests on flawed specimens showed that the prestressed composite spar construction significantly suppresses crack growth. Damage from three high velocity 30 caliber projectile hits was confined to three small holes in the ballistic test specimen. No fragmentation or crack propagation was observed indicating good ballistic damage resistance. Rotor attachment approaches and improved structural performance configurations were identified. Design theory was verified by tests. The prestressed composite spar configuration consisted of a compressively prestressed high strength ARDEFORM 301 stainless steel liner overwrapped with pretensioned S-994 fiberglass. Author

**N75-21268\*** Lockheed-California Co., Burbank.  
**ADVANCED SUPERSONIC TECHNOLOGY CONCEPT STUDY: HYDROGEN FUELED CONFIGURATION, SUMMARY REPORT**

G D Brewer and R E Morris Washington NASA Apr 1975  
 53 p refs  
 (Contract NAS2-7732)

(NASA-CR-2534, LR-26322) Avail NTIS HC \$4 25 CSCL 01C

Conceptual designs of hydrogen fueled supersonic transport configurations for the 1990 time period were developed and compared with equivalent technology Jet A-1 fueled vehicles to determine the economic and performance potential of liquid hydrogen as an alternate fuel. Parametric evaluations of supersonic cruise vehicles with varying design and transport mission characteristics established the basis for selecting a preferred configuration. An assessment was made of the general viability of the selected concept including an evaluation of costs and environmental considerations, i.e., exhaust emissions and sonic boom characteristics. Technology development requirements and suggested implementation schedules are presented. Author

**N75-21269\*** United Air Lines, Inc., Denver, Colo  
**ENGINEERING FLIGHT AND GUEST PILOT EVALUATION REPORT, PHASE 2**

John A Morrison, Erik B Anderson, Gordon W Brown, and George K Schwind 15 Nov 1974 143 p

(Contract NAS2-7475)

(NASA-CR-137664) Avail NTIS HC \$5 75 CSCL 01C

Prior to the flight evaluation, the two-segment profile capabilities of the DC-8-61 were evaluated and flight procedures were developed in a flight simulator at the UA Flight Training Center in Denver, Colorado. The flight evaluation reported was conducted to determine the validity of the simulation results, further develop the procedures and use of the area navigation system in the terminal area, certify the system for line operation, and obtain evaluations of the system and procedures by a number of pilots from the industry. The full area navigation capabilities of the special equipment installed were developed to provide terminal area guidance for two-segment approaches. The objectives of this evaluation were (1) perform an engineering flight evaluation sufficient to certify the two-segment system for the six-month in-service evaluation, (2) evaluate the suitability of a modified RNAV system for flying two-segment approaches, and (3) provide evaluation of the two-segment approach by management and line pilots. Author

**N75-21270\*** National Aeronautics and Space Administration  
 Langley Research Center, Langley Station, Va

**DYNAMIC-STABILITY TESTS ON AN AIRCRAFT ESCAPE MODULE AT MACH NUMBERS FROM 0.40 TO 2.16** Final Report

Edwin E Davenport and Robert A Kilgore 16 Apr 1975 58 p refs

(NASA-TM-X-72680) Avail NTIS HC \$4 25 CSCL 01C

Wind-tunnel measurements of the aerodynamic damping and oscillatory stability of a model of a proposed escape module for a military aircraft have been made using a small-amplitude forced-oscillation technique in pitch and yaw at Mach numbers from 0.40 to 2.16 and in roll at Mach numbers from 0.40 to 1.20. The results in pitch indicate regions in the angle-of-attack range where the model exhibits large and rapid changes in both damping and stability with angle of attack, probably caused by vortex flow over the fins. There was no pronounced effect of change in angle of attack on damping in yaw. Except for the highest Mach number, negative damping in roll was produced at high negative angles of attack. Author

**N75-21271\*** National Aeronautical Establishment, Ottawa (Ontario)

**CORRELATION OF FATIGUE DATA FOR ALUMINUM AIRCRAFT WING AND TAIL STRUCTURES**

R Hangartner Dec 1974 48 p refs  
 (NRC-14555, LR-582, ISSN-0077-5541) Avail NTIS  
 HC \$3 75

S-N curves are derived for aluminum wing and tail structures by fitting various regression models to 246 full scale constant amplitude fatigue test results from twelve types of aircraft structures. The derived curves were tested by comparing the predicted lives with actual test results of various aircraft structures fatigue tested to variable-amplitude loads spectra. More reliable predictions resulted from these derived S-N curves than from existing S-N curves. Author

**N75-21272\*** Army Aviation Engineering Flight Activity, Edwards AFB, Calif

**TAIL ROTOR SHAFT VIBRATION SURVEY PRODUCTION UH-1H HELICOPTER** Final Report, 19 Mar. - 4 Apr. 1974

Emmett J Laing, Michael A Hawley, and Arnold E Weand, Jr Jul 1974 70 p refs

(AD-A002574, USAAEFA-73-10) Avail NTIS CSCL 01/3

Tail rotor shaft vibration measurement tests were conducted on a production UH-1H helicopter to define tail rotor shaft vibration characteristics during ground runs. Testing was performed by the United States Army Aviation Engineering Flight Activity at Edwards Air Force Base, California, between 19 March and 4 April 1974. The testing consisted of 11 ground runs totaling one productive test hour. Vibration data were recorded from 7 accelerometer locations for 11 tail rotor shaft configurations, and narrow band spectral analyses were performed on the vibration data. GRA

**N75-21273#** Boeing Aerospace Co., Seattle, Wash Research and Engineering Div  
**INVESTIGATION OF UPPER SURFACE BLOWING APPLIED TO HIGH SPEED AIRCRAFT** Final Technical Report, 1 May 1973 - 2 May 1974

Kichio K Ishimitsu 2 Jul 1974 247 p refs  
 (Contract F33615-73-C-3137, AF Proj 1207)  
 (AD-A003325, AFFDL-TR-74-89) Avail NTIS CSCL 01/3

A preliminary evaluation of transonic, propulsive, life augmentation system known as upper surface blowing USB has been completed. USB is a thick jet, jet flap powered lift concept which uses a trailing edge flap and the coanda effect to vector the jet engine exhaust for lift augmentation. A wind tunnel test has demonstrated lift induction increments 1 1/2 to 3 times the thrust vectored component in the lift direction. An estimate of a USB fighter performance shows a possible 40 knot reduction in approach speed and a 10% reduction in turn radius for a maximum sustained G turn at mach 0.90 and 30,000 feet altitude. GRA

**N75-21274#** Naval Air Development Center, Warminster, Pa Crew Systems Dept

**A COMPUTER STUDY OF ACCELERATION DEVELOPED BY A VERTICAL SEEKING EJECTION SEAT**

E Fessenden, G Hildebrand, and R J Crosbie 18 Nov 1974 36 p refs  
 (F41451402)

(AD-A002970, NADC-74229-40) Avail NTIS CSCL 01/3

With the advent of the V/STOL aircraft and its application in the attack role, it has become obvious that a traditional ejection seat will not fulfill all the escape requirements peculiar to this type of aircraft. In an effort to overcome this difficulty, the concept of vertical seeking is offered. The basic philosophy here is to rotate the seat/man configuration into a vertical position as soon as the cockpit is cleared and then thrust it upward in a stabilized trajectory to an altitude that will permit safe recovery. The effort to date has been a limited parametric computer study aimed at obtaining baseline design data investigations into the physiological stress that will be imposed on the crewman. The main topic of the paper is the discussion of acceleration and load definition and then the influence of various operational parameters on them. GRA

**N75-21275#** Air Force Inst of Tech., Wright-Patterson AFB, Ohio School of Engineering

**JOINT GENERALIZED LEAST SQUARES APPLIED TO COST ESTIMATION FOR FIGHTER AIRCRAFT M.S. Thesis**

Patrick W OBrien Dec 1974 103 p refs  
 (AD-A003354, GSA/SM/74D-7) Avail NTIS CSCL 01/3

Joint Generalized Least Squares is an extension of least squares techniques which decreases statistical uncertainty in derived regression equations. The technique is applied to historical costs for airframes, avionics, and engines in fighter aircraft. A comparison is made of parametric cost estimating relationships derived using ordinary and Joint Generalized Least Squares to demonstrate reductions in statistical uncertainty. GRA

**N75-21277#** Air Force Inst of Tech., Wright-Patterson AFB, Ohio School of Engineering

**COST ESTIMATING RELATIONSHIPS FOR PROCUREMENT COSTS OF AIRBORNE DIGITAL COMPUTERS AND INERTIAL MEASUREMENT UNITS FOR USE IN REMOTELY PILOTED VEHICLES M.S. Thesis**

Kenneth V Funkhouser Dec 1974 82 p refs  
 (AD-A003353, GSA/SM/74D-3) Avail NTIS CSCL 01/3

Parametric cost estimating relationships (CER's) are developed to predict procurement costs of airborne digital computers and inertial measurement units which are suitable for use in remotely piloted vehicles (RPV's). The CER's predict first unit recurring cost in 1974 dollars and can be incorporated with an appropriate learning curve to estimate average cost for a given production quantity. A brief discussion of a computerized parametric cost estimation technique, the RCA PRICE model, is provided to compare methodology, input requirements, and output. The predictive capabilities of the RPV CER's are compared to

avionics procurement CER's developed by the Air Force Avionics Laboratory. The RPV CER's are generally more accurate than the AFAL CER's when procurement costs of equipment usable in remotely piloted vehicles are being estimated. GRA

**N75-21278\*#** Pratt and Whitney Aircraft, East Hartford, Conn  
**TWO-STAGE FAN. 3: DATA AND PERFORMANCE WITH ROTOR TIP CASING TREATMENT, UNIFORM AND DISTORTED INLET FLOWS**

G D Burger, T R Hodges, and M J Keenan Mar 1975 187 p refs

(Contract NAS3-13494)

(NASA-CR-134722, PWA-5239) Avail NTIS HC \$7.00 CSCL 21E

A two stage fan with a 1st-stage rotor design tip speed of 1450 ft/sec, a design pressure ratio of 2.8, and corrected flow of 184.2 lbm/sec was tested with axial skewed slots in the casings over the tips of both rotors. The variable stagger stators were set in the nominal positions. Casing treatment improved stall margin by nine percentage points at 70 percent speed but decreased stall margin, efficiency, and flow by small amounts at design speed. Treatment improved first stage performance at low speed only and decreased second stage performance at all operating conditions. Casing treatment did not affect the stall line with tip radially distorted flow but improved stall margin with circumferentially distorted flow. Casing treatment increased the attenuation for both types of inlet flow distortion. Author

**N75-21279\*#** Boeing Commercial Airplane Co., Seattle, Wash  
**TITANIUM HONEYCOMB ACOUSTIC LINING STRUCTURAL AND THERMAL TEST REPORT** Technical Report, Jan. - Aug. 1974

Donald Joynes and Jan P Balut Dec 1974 77 p refs

(Contract NAS3-17842)

(NASA-CR-134783, D6-42352) Avail NTIS HC \$4.75 CSCL 20A

The results are presented of static, fatigue and thermal testing of titanium honeycomb acoustic panels representing the acoustic tailpipe for the Pratt and Whitney Aircraft JT8D Refan engine which is being studied for use on the Boeing 727-200 airplane. Test specimens represented the engine and tailpipe flange joints, the rail to which the thrust reverser is attached and shear specimens of the tailpipe honeycomb. Specimens were made in four different batches with variations in configuration, materials and processes in each. Static strength of all test specimens exceeded the design ultimate load requirements. Fatigue test results confirmed that aluminum brazed titanium, as used in the Refan tailpipe design, meets the fatigue durability objectives. Quality of welding was found to be critical to life, with substandard welding failing prematurely, whereas welding within the process specification exceeded the panel skin life. Initial fatigue testing used short grip length bolts which failed prematurely. These were replaced with longer bolts and subsequent testing demonstrated the required life. Thermal tests indicate that perforated skin acoustic honeycomb has approximately twice the heat transfer of solid skin honeycomb. Author

**N75-21280\*#** National Aeronautics and Space Administration  
 Lewis Research Center, Cleveland, Ohio

**ANALYSIS OF GROUND REFLECTION OF JET NOISE OBTAINED WITH VARIOUS MICROPHONE ARRAYS OVER AN ASPHALT SURFACE**

J H Miles 1975 44 p refs Presented at the 89th Meeting of the Acoust Soc of Am., Austin, Tex., 8-11 Apr 1975

(NASA-TM-X-71696 E-8299) Avail NTIS HC \$3.75 CSCL 2A

Ground reflection effects on the propagation of jet noise over an asphalt surface are discussed for data obtained using a 33.02-cm diameter nozzle with microphones at several heights and distances from the nozzle axis. Ground reflection effects are analyzed using the concept of a reflected signal transfer function which represents the influence of both the reflecting surface and the atmosphere on the propagation of the reflected signal in a mathematical model. The mathematical model used as a basis for the computer program was successful in significantly reducing the ground reflection effects. The range of values of



the single complex number used to define the reflected signal transfer function was larger than expected when determined only by the asphalt surface. This may indicate that the atmosphere is affecting the propagation of the reflected signal more than the asphalt surface. The selective placement of the reinforcements and cancellations in the design of an experiment to minimize ground reflection effects is also discussed. Author

**N75-21281#** Tennessee Univ Space Inst, Tullahoma  
**SOME RESULTS OF AEROACOUSTIC RESEARCH**  
 B H Goethert [1974] 13 p refs  
 Avail NTIS HC \$3 25

Fundamental and applied research in the field of exhaust jet noise, emphasizing the special noise producing characteristics of unconventional exhaust nozzles as multi-circular, slot, and those with noise flap shields are reported. Studies were initiated on exhaust jets, which mix with secondary air underneath a shroud. The guiding idea of such configurations is to have the region of high turbulence and thus also of intense noise shielded from the outside, and have the exhaust jet discharged into the atmosphere at greatly reduced velocities. At such reduced velocities, the externally generated noise is greatly reduced, and in conjunction with the internal shielding of the primary jet, a significant reduction of the total exhaust noise can be expected. Author

**N75-21283\*#** National Aeronautics and Space Administration  
 Lewis Research Center, Cleveland, Ohio  
**EFFECT OF CASING TREATMENT ON PERFORMANCE OF A MULTISTAGE COMPRESSOR**

Leon M Wenzel, John E Moss, Jr., and Charles M Mehalic  
 Washington Jan 1975 31 p refs  
 (NASA-TM-X-3175, E-8085) Avail NTIS HC \$3 75 CSCL 21E

AJ85-GE-13 engine was equipped with a compressor case which allowed changes to the case wall over the rotor tips of six of its stages. The engine was tested with four inlet configurations: undistorted and with 180 deg circumferential, hub radial, and tip radial distortions. Baseline data defining compressor performance and stall regions were taken for these inlet configurations with solid (untreated) compressor case inserts. Circumferentially grooved inserts were installed in the first three and last three stages, and the compressor was mapped under similar conditions. The compressor was mapped a third time with untreated inserts in the first three stages and inserts having slots conforming to blade angles in the last three stages. In most cases, the stall pressure ratio was the same as or lower than the baseline. Pumping capacity with the slotted inserts was reduced. Overall compressor efficiency with the grooved rings installed did not appreciably differ from the baseline, but it was 1 to 2 percentage points lower than the baseline with the slotted rings in place. Average stage characteristics for the undistorted inlet case showed little or no sensitivity to casing treatment. Author

**N75-21285#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**MUFFLING THE NOISE OF POWER PLANTS WHICH USE GAS-TURBINE AIRCRAFT ENGINES**

I P Stepanov, A N Uspenskiy, and S N Uvarov 18 Nov 1975 14 p refs Transl into ENGLISH from Prom Energ (Moscow), no 11, Nov 1971 p 52-54  
 (AD-A002830, FTD-HT-23-0035-75) Avail NTIS CSCL 21/5

This article describes the results of measurements of the noise level of a gas-turbine generator (GTU) with an output power of 20 kW and of the attempts to construct an exhaust noise muffler for it. GRA

**N75-21286#** Fiber Science, Inc., Gardena, Calif  
**TUBULAR COMPOSITE HLH ROTOR BLADE SECTION** Final Report, Nov. 1972 - Dec 1973  
 Sam Yao and Dale Abildskov Nov 1974 69 p

(Contract DAAJ02-73-C-0025, DA Proj 1X2-63203-D-156)  
 (AD-A003330, USAAMRDL-TR-74-95) Avail NTIS CSCL 01/3

This report describes the results of a research and development program to design, analyze, and fabricate a 16-foot-long section, including the root end attachment, of an HLH size rotor blade. The design of the blade section was based upon the tubular-reinforced-composite wet-filament-wound concept. GRA

**N75-21287#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**DEVICE FOR SIMULATING THE FUEL-CONTROL APPARATUS OF AN AIRCRAFT ENGINE**

F A Korotkov and A N Dobrynin 25 Nov 1974 9 p Transl into ENGLISH from Russian Patent no 305488 (4 Jun 1971) 2 p

(AD-A002819, FTD-HT-23-242-75) Avail NTIS CSCL 21/5  
 This invention involves the designing of electrosimulation benches intended for testing the controls of turboreactive engines, for example, basic contour controls. GRA

**N75-21288#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**BYPASS TURBOJET ENGINE NOISE CHARACTERISTICS ON THE TEST STAND**

V G Eenenkov 20 Nov 1974 36 p refs Transl into ENGLISH from Rishskii Inst Inzh Grazhdanskoi Aviats Tr (USSR), no 174, 1971 p 3-4, 100-134  
 (AD-A003086, FTD-HC-23-862-74) Avail NTIS CSCL 21/5

The report examines the acoustic characteristics of the primary noise sources of BTJE operating on the test stand. The acoustic characteristic concepts are discussed and methods for computational determination of these characteristics are given. Information is presented on the noise excitation mechanisms. The data of experimental studies of the noise of BTJE with bypass ratio  $\gamma = 0 \dots 6$  are analyzed. GRA

**N75-21289\*#** Boeing Commercial Airplane Co., Seattle, Wash  
**REDUNDANT ACTUATOR DEVELOPMENT PROGRAM** Final Report

C C Chenoweth, D M Fain, and C I Svensson Apr 1975 170 p  
 (Contract NAS2-7966)  
 (NASA-CR-137656, D6-46457) Avail NTIS HC \$6 25 CSCL 01C

Two concepts of redundant secondary actuator mechanization, applicable to future advanced flight control systems, were studied to quantitatively assess their design applicability to an AST. The two actuator concepts, a four-channel, force summed system and a three-channel, active/standby system have been developed and evaluated through analysis, analog computer simulation, and piloted motion simulation. The quantitative comparison of the two concepts indicates that the force summed concept better meet performance requirements, although the active/standby is superior in other respects. Both concepts are viable candidates for advanced control application dependent on the specific performance requirements. Author

**N75-21290#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**CRITERIA OF THE LONGITUDINAL STABILITY OF THE EKRANOPLAN**

R D Irodov 20 Nov 1974 20 p refs Transl into ENGLISH from Uch Zap Tsentr Aerogidrodinamicheskii Inst (USSR), v 1, no 4, 1970 p 63-72  
 (AD-A002918, FTD-MT-24-2792-74) Avail NTIS CSCL 01/3

Some questions are examined of the longitudinal stability of the ekranoplan (This term is a transliteration from the Russian and not listed in dictionaries, it is believed to be some kind of air-cushion vehicle which moves over the surface on an air cushion) directly connected with the selection of its aerodynamic design. GRA

**N75-21301#** Air Force Systems Command, Wright-Patterson AFB, Ohio

**FIVE MINUTES BEFORE TAKEOFF**

P Savin 6 Dec 1974 8 p Trans into ENGLISH from Bakinski Rabochii (USSR), no 102 Apr 1973 p 3, 30  
(AD-A002815, FTD-HT-23-205-75) Avail NTIS CSCL 01/3

At the present time the airport servicing of aircraft and the electrical starting of aircraft engines is accomplished by various electrical power sources on the ground GRA

**N75-21608#** Applied Technology, Sunnyvale, Calif

**VERTICAL BARGRAPH DISPLAY Final Report**

Glen F Ingle Sep 1974 40 p

(Contract DAAB07-73-C-0256)

(AD-A002695, ECOM-73-0256-F) Avail NTIS CSCL 09/5

The program was divided into three separate technical efforts, (1) the mechanical packaging (2) the electronic circuitry and (3) the liquid crystal plates. The packaging and circuitry efforts proceeded quite smoothly. There were some modifications in both areas due to the desire for interchangeability of LC panels for evaluation purposes and variations in lighting schemes but the basic packaging and circuitry concepts proved satisfactory. The liquid crystal plates proved a difficult matter. Because of the subjective evaluation required of the LC panel, it was impossible to ascertain the best LC cosmetic arrangement. Rather, a series of various combinations of LC materials, backplates and lighting systems were assembled and tried. Parallax-face scales combined with effective glass seals also required extensive experimentation GRA

**N75-21642#** SKF Industries, Inc., King of Prussia, Pa

**FEASIBILITY OF INDUCTION SKIN HARDENED TAPERED ROLLER BEARINGS FOR ENGINE MAIN SHAFT AND TRANSMISSION PINION APPLICATIONS Final Technical Report, 2 Oct 1972 - 2 Jul 1974**

J W Rosenlieb, H M Martinie and R E Maurer Nov 1974 71 p refs

(Contract DAAJ02-73-C-0009, DA Proj 1F2-62209-AH-76)

(AD-A003314, SKF-AL74T023, USAAMRDL-TR-74-90) Avail NTIS CSCL 13/9

The purposes of this program were (1) to improve the design of ultrahigh-speed tapered roller bearings based on the computer analyses and test results previously reported under Contract DAAJ02-70-C-0047, and (2) to develop the required technology to induction skin harden M-50 tool steel rings of relatively thin cross section for use in the manufacture of aircraft rolling bearings GRA

**N75-21681#** Boeing Vertol Co., Philadelphia, Pa

**USE OF THE FINITE ELEMENT DAMPED FORCED RESPONSE STRAIN ENERGY DISTRIBUTION FOR VIBRATION REDUCTION Final Report, Jul 1971 - Jul. 1974**

John J Sciarra Jul 1974 224 p refs

(Contract DAHC04-71-C-0048)

(AD-A002756, D210-10819-1) Avail NTIS CSCL 01/3

Analysis has previously been developed verifying that a minimum weight structure with a specified natural frequency is one wherein the density differential (strain energy density less kinetic energy density) is uniform throughout the structure when deformed in its natural mode. Using the convenience of the finite element method, the density differential (or as an approximation the strain density) of each structural element may be obtained for a given natural mode. This concept is extended here from the modal method to a damped forced response method wherein the strain density is determined for all the structural elements acting under a steady state vibratory loading. Application of energy methods to vibration reduction of the Boeing Vertol Model 347 Tandem Helicopter is shown. Advantages of the damped forced response method as well as other applications are given GRA

**N75-21805#** Army Electronics Command, Fort Monmouth, NJ  
**DATA ACQUISITION TEST REPORT ON OH-58A NiCad BATTERY OPERATION Final Technical Report**

James T Maguire Oct 1974 79 p refs

(DA Proj 1F2-64201-DC-97)

(AD-A001526, ECOM-4267) Avail NTIS CSCL 10/3

This report describes the data collection effort on an OH-58A to provide information to allow implementation of a laboratory simulation of battery loading under controlled conditions. A tabulation and graphical display of the recorded results are contained in Appendix 3. Procedures for the installation and testing have been detailed in Appendices 1 and 2 GRA

**N75-22021** Polish Academy of Sciences, Warsaw

**THE PECULIAR CASE OF REPRESENTING A PROFILE PAIR ON A CIRCUMFERENCE PAIR [O SZCZEGOLNYM PRZYPADKU ODWZOROWANIA PARY PROFILOW NA PARE OKREGOW]**

Włodzimierz J Prosnak 23 Sep 1973 78 p refs In POLISH (Rept-2/1973) Avail Issuing Activity

A method is presented for determining a function representing a pair of given profiles, symmetrical relative to the real axis, on a pair of circumferences. Two computer programs are presented in ALGOL-1204 programming language. The first enables automatic calculation of coefficients of a series, and the second controls the accuracy of the obtained representations

Transl by M J S

**N75-22080** Shape Air Defense Technical Center, The Hague (Netherlands)

**INFLUENCE OF TOPOGRAPHY AND ATMOSPHERIC REFRACTION IN UHF GROUND-AIR COMMUNICATIONS**

A N Ince and H P Williams In AGARD Electromagnetic Wave Propagation Involving Irregular Surfaces and Inhomogeneous Media Feb 1975 26 p refs

The results of field strength measurements in UHF ground-air communication using four different ground terminals are presented. The local conditions at the ground terminals varied considerably. In one case the site was flat and clear over a distance of 2 km, in another the site was the highest in the district, a third site had nearby buildings, while the fourth site had marked local undulations and a nearby valley. In all four cases the field strength at the optical horizon was very close to the theoretical value for a smooth earth. The field strength at this point was virtually unaffected by the local ground conditions. Using this fact, and taking into account the statistics of atmospheric refraction it is possible to predict the reliability of UHF ground-to-air communication for high-flying aircraft Author

**N75-22082** European Space Research Organization, Noordwijk (Netherlands)

**MULTIPATH IN AN AERONAUTICAL SATELLITE SYSTEM**

H J Wuennenberg In AGARD Electromagnetic Wave Propagation Involving Irregular Surfaces and Inhomogeneous Media Feb 1975 18 p refs

The multipath problem as encountered in a civil aeronautical satellite system is analyzed. A model for the multipath reflection is developed and the performance of the communications channels through the satellite is evaluated. The aeronautical satellite system will be used to control air traffic over the Atlantic and Pacific oceans. Aircraft will fly at a height of 10 to 20 km. Severe impairment of the communications performance is expected due to reflection of radiowaves from the surface of the sea and inadequate protection by the aircraft antenna against multipath. A simple theoretical model for reflections from the sea is developed. Under the assumption that only very simple coding schemes can be used to improve the bit error rate for digital transmissions the application of frequency diversity, space

diversity and time diversity is discussed. It is shown that frequency diversity is more suitable for the link from the satellite to the aircraft while space diversity can be used for the link from the aircraft to the satellite. The application of time diversity does not reduce the bit error rate by a great amount because of correlation between consecutive bits. It is shown that large delays between messages are necessary to make time diversity attractive. Time diversity would therefore lead to coding by blocks and to storage requirements. Author

**N75-22267#** Army Aviation Systems Command, St Louis Mo  
**MAJOR ITEM SPECIAL STUDY (MISS) OH-58A MAIN ROTOR BLADE** Interim Report, Jan 1964 - Jul 1973  
Oct 1974 24 p refs  
(AD-A000797/1, USAAVSCOM-TR-74-44) Avail NTIS HC \$3.25 CSCL 01/3

The report is designed to illustrate how cost savings can result by analyzing reported removal data from fielded Army aircraft. Certain equipment, because of finite life, high cost, or need for intensive management, is classified as reportable for control purposes on the DA Form 2410. The MISS report investigates these components for possible cost savings based upon total elimination of selected failure modes. GRA

**N75-22272** North Carolina State Univ., Raleigh  
**APPLICATION OF EXTERNAL AERODYNAMIC DIFFUSION TO SHROUDED PROPELLER NOISE REDUCTION** Ph.D. Thesis

Richard Edward Longhouse 1974 138 p  
Avail Univ Microfilms Order No 75-7678

The noise reduction potential of external aerodynamic diffusion (EAD) when applied to V/STOL shrouded propellers during hover operation was investigated. The EAD is characterized by a short, highly divergent diffuser with boundary layer control. The rotor-stator interaction noise of a subsonic rotor was considered. A rotor with upstream stator blades was constructed. Diffuser boundary layer control was incorporated and an anechoic chamber was constructed. Model thrust and rotation speed were monitored. The results indicate that EAD is effective in reducing rotor-stator potential interaction noise. Overall noise reduction appears to depend on the relative magnitude of the two types of noise mechanisms. Dissert Abstr

**N75-22275\*#** National Aeronautics and Space Administration  
Flight Research Center, Edwards, Calif  
**COMPARISONS OF WING PRESSURE DISTRIBUTION FROM FLIGHT TESTS OF FLUSH AND EXTERNAL ORIFICES FOR MACH NUMBERS FROM 0.50 TO 0.97**

Lawrence C Montoya and David P Lux Apr 1975 26 p refs  
(NASA-TM-X-56032) Avail NTIS HC \$3.75 CSCL 01A

Wing pressure distributions obtained in flight with flush orifice and external tubing orifice installations for Mach numbers from 0.50 to 0.97 are compared. The procedure used to install the external tubing orifice is discussed. The results indicate that external tubing orifice installations can give useful results. Author

**N75-22276\*#** National Aeronautics and Space Administration  
Ames Research Center, Moffett Field, Calif  
**AN APPROXIMATE CLOSED-FORM SOLUTION FOR LEAD LAG DAMPING OF ROTOR BLADES IN HOVER**

David A Peters Apr 1975 27 p refs  
In cooperation with Army Air Mobility R and D Lab, Moffett Field, Calif  
(NASA-TM-X-62425, A-6025) Avail NTIS HC \$3.75 CSCL 01A

Simple stability methods are used to derive an approximate closed-form expression for the lead-lag damping of rotor blades in hover. Destabilizing terms are shown to be a result of two dynamic mechanisms. First, the destabilizing aerodynamic forces that can occur when blade lift is higher than a critical value are

maximized when the blade motion is in a straight line equidistant from the blade chord and the average direction of the air flow velocity. This condition occurs when the Coriolis terms vanish and when the elastic coupling terms align the blade motion with this least stable direction. Second, the nonconservative stiffness terms that result from pitch-flap or pitch-lag coupling can add or subtract energy from the system depending upon whether the motion of the blade tip is clockwise or counterclockwise. Author

**N75-22278\*#** National Aeronautics and Space Administration  
Lewis Research Center, Cleveland, Ohio

**EFFECT OF ENTRY-LIP DESIGN ON AERODYNAMICS AND ACOUSTICS OF HIGH THROAT MACH NUMBER INLETS FOR THE QUIET, CLEAN, SHORT-HAUL EXPERIMENTAL ENGINE**

Brent A Miller, Benjamin J Dastoli, and Howard L Wesoky  
Washington May 1975 45 p refs  
(NASA-TM-X-3222, E-8160) Avail NTIS HC \$3.75 CSCL 01A

Results of scale model tests of high-throat-Mach-number inlets designed to suppress inlet-emitted engine machinery noise produced in a V/STOL wind tunnel are presented. A vacuum system was used to induce inlet airflow with a siren as a noise source. Inlet mass flow was 11.68 kilograms (25.75 lb/min) per second at a throat Mach number of 0.79. The effect of entry-lip design (contraction ratio and diameter ratio) on inlet total-pressure recovery, steady-state pressure distortion, performance at high incidence angles, and noise suppression was determined. With proper entry-lip design, total-pressure recovery in excess of 0.988 could be obtained statically at an average throat Mach number of 0.79. Total-pressure distortion was 5 percent. The reduction in the siren tone sound pressure level transmitted through the inlet was 10 to 14 db relative to that measured at throat Mach 0.6. Author

**N75-22279\*#** Boeing Commercial Airplane Co., Seattle, Wash  
**AERODYNAMIC DESIGN AND ANALYSIS SYSTEM FOR SUPERSONIC AIRCRAFT PART 2 USER'S MANUAL** Final Report

W D Middleton, J L Lundry, and R G Coleman Washington  
NASA Mar 1975 198 p refs  
(Contract NAS1-12052)  
(NASA-CR-2521, D6-41759-Pt-2) Avail NTIS HC \$7.00 CSCL 01C

An integrated system of computer programs for supersonic configurations is described. An explanation of system usage, the input definitions, and example output are included. Author

**N75-22280#** Advisory Group for Aerospace Research and Development, Paris (France)

**AIRCRAFT STALLING AND BUFFETING**

Feb 1975 169 p refs In ENGLISH, partly in FRENCH  
(AGARD-LS-74) Avail NTIS HC \$6.25

Lectures on the subject of aircraft stalling and buffeting are presented. The scope of the presentations involves recent developments in the understanding of the fluid dynamics of aerodynamic stalling and buffeting, the dynamic response of the aircraft, and techniques for buffet prediction, with consideration of the implications for aircraft design. For individual titles see N75-22281 through N75-22287.

**N75-22281** Royal Aircraft Establishment, Bedford (England)  
**AIRCRAFT STALLING AND BUFFETING INTRODUCTION AND OVERVIEW**

C R Taylor In AGARD Aircraft Stalling and Buffeting Feb 1975 18 p refs

The phenomena of aircraft stalling and buffeting are analyzed with respect to the influence exerted by various aerodynamic configurations. Variations of the lift coefficient of a wing with changes in angle of incidence and Mach number are examined to show the effect on the stalling characteristics. Aerodynamic designs which provide a uniform pressure distribution as a method for delaying the onset of aerodynamic stall are described. Block diagrams are developed to show the relationships of aerodynamic

forces and aerodynamic effects for structural buffeting and rigid-body dynamics. The limitations imposed on aircraft maneuverability by the onset of aerodynamic stall are explained. Author

**N75-22282** Douglas Aircraft Co., Inc., Long Beach, Calif  
**REMARKS ON FLUID DYNAMICS OF THE STALL**  
A M O Smith /In AGARD Aircraft Stalling and Buffeting Feb 1975 33 p refs

An analysis of aerodynamic stalling based on fluid mechanics phenomena is presented. Emphasis is placed on the flow separation which occurs during a stall and flow photographs of such events are provided. Limits to pressure rise for both laminar and turbulent flows are given, as well as their general theory. The effects of Reynolds number, Mach number, and airfoil shape on flow separation are examined. Diagrams of the conditions existing in full aircraft stall and buffeting process are developed. The problem of calculating flows with separation is discussed.

Author

**N75-22283** Boeing Co., Seattle, Wash  
**PREDICTION AND ANALYSIS OF THE LOW SPEED STALL CHARACTERISTICS OF THE BOEING 747**  
William McIntosh and John K Wimpers /In AGARD Aircraft Stalling and Buffeting Feb 1975 21 p

Wind tunnel tests for estimating the stall speed of the Boeing 747 aircraft were conducted. The test results were adjusted to full scale flight values using correlation factors developed from other transport aircraft designs. Flight results showed a reasonable degree of success in predicting stall speeds. A further analysis was made to show the effects of aeroelastic and airplane dynamics in accurately predicting aerodynamic stall.

Author

**N75-22284** Office National d'Etudes et de Recherches Aeronautiques, Paris (France)  
**FLOW SEPARATION AND AERODYNAMIC EXCITATION AT TRANSONIC SPEEDS**  
B Monnerie /In AGARD Aircraft Stalling and Buffeting Feb 1975 14 p refs. In FRENCH, ENGLISH summary

The effects that the birth and growth of separated flow areas on an aerospace vehicle surface have on aerodynamic stalling and buffeting are discussed. The separated flow areas are defined as those points of turbulent flow which produce high level pressure fluctuations and excite the vehicle structure. The influence of strong positive pressure gradients in the transonic regime is analyzed. The computation of buffeting intensity is analyzed with respect to the characteristics of the unsteady pressure field.

Author

**N75-22285** Royal Aircraft Establishment, Bedford (England)  
**AIRCRAFT DYNAMIC RESPONSE ASSOCIATED WITH FLUCTUATING FLOW FIELDS**  
J G Jones /In AGARD Aircraft Stalling and Buffeting Feb 1975 15 p refs

The interactions of fluctuating flow fields and the dynamic response of aircraft structures which results in buffeting are discussed. A basic feature of the dynamic analysis of buffeting is the closed-loop interaction between the fluctuating fluid motion and the motion of the wing surface. The problem of formulating an appropriate theoretical model for structural buffeting is discussed, together with the analogous situation involving response in rigid-body modes, including the oscillatory motion known as wing-rocking.

Author

**N75-22286** British Aircraft Corp., Warton (England) Aerodynamics Dept  
**PRE-STALL BEHAVIOR OF COMBAT AIRCRAFT**  
D E Shaw /In AGARD Aircraft Stalling and Buffeting Feb 1975 18 p refs

High incidence, pre-stall behavior of combat aircraft is discussed in terms of fluid flow characteristics and the corresponding flight dynamic phenomena. Emphasis is placed on the aerodynamic phenomena which are defined as wing-rock. The phenomena are associated with a collapse of the dutch roll

characteristics to a divergent rolling oscillation and with the rigid airframe response in the dutch roll mode to the low frequency content of wing buffet.

Author

**N75-22287** Messerschmitt-Boelkow-Blohm GmbH, Munich (West Germany)

**CRITICAL REVIEW OF METHODS TO PREDICT THE BUFFET PENETRATION CAPABILITY OF AIRCRAFT**

Helmut John /In AGARD Aircraft Stalling and Buffeting Feb 1975 29 p refs

A general survey of methods for predicting the buffet penetration capability of various aircraft is presented. The influence of aerodynamic buffeting on the performance and maneuverability of aircraft is discussed. The prediction of buffeting intensity on the basis of mean aerodynamic loads is examined. Mathematical models of the buffet response to determine loads and peak accelerations are developed. Wind tunnel tests for determining stall characteristics using a forced vibration model in one case and a nonlinear flutter model in the second case are described.

Author

**N75-22289#** Saarland Univ., Saarbrücken (West Germany) Inst fuer Mathematik

**INVESTIGATION OF SOUND EMISSION FROM A JET ENGINE INLET IN AN AXIAL FLOW** Ph D Thesis

Norbert Friedrich Porz, West Ger DFVLR 3 Feb 1975 232 p refs. In GERMAN, ENGLISH summary (DLR-FB-75-24) Avail NTIS HC\$7 50, DFVLR, Porz, West Ger 77.90 DM

An idealized model is considered of a jet engine inlet situated in an inviscid compressible gaseous medium flowing through and past it at a speed less than that of sound. A spinning mode is generated in the engine far down-stream from the opening. The induced velocity and pressure fields are calculated using the linearized theory of sound waves of small amplitudes. In particular, reflection coefficients and the far field are determined and the case of small duct widths is discussed.

Author (ESRO)

**N75-22293#** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**THREE DIMENSIONAL BOUNDARY LAYER IN A VICINITY OF THE CRITICAL LINE OF THE SLIDING WING WITH NONUNIFORM SUCTION**

V A Barinov 13 Feb 1975 26 p refs. Transl into ENGLISH from Uch Zap. Tsentr Aerogidrodinamicheskii Inst (USSR) v 3 no 1, 1972 p 23-29 (AD-A007194, FTD-MT-24-0423-75) Avail NTIS CSCL 01/3

A numerical method for calculating the equations of the incompressible boundary layer is presented, which is a generalization of the method for determining integral relationships of the three dimensional boundary layer. Results are given of the performance calculation of the boundary layer for different distribution laws of suction along the leading edge of a wing.

Author

**N75-22295#** Defense Documentation Center Alexandria Va  
**USE OF HELICOPTERS FOR AIR DELIVERY AND EMERGENCY** Report Bibliography, Sep 1954 - May 1974

Mar 1975 66 p refs (AD-A006750, DDC-TAS-75-2) Avail NTIS CSCL 01/2

This bibliography contains citations of 39 unclassified reports dealing with use of helicopters for air delivery and emergency, aerial delivery air drop operations, search and rescue, and emergency medical care. Corporate Author-Monitoring Agency, Subject, Title, Personal Author, Contract and Report Number Indexes are included.

GRA

**N75-22296#** Air Force Systems Command Wright-Patterson AFB, Ohio Foreign Technology Div

**EVALUATION OF THE EFFECT OF TRANSIENCY IN THE FLUTTER ANALYSIS OF AIRCRAFT WITH THE WING OF THE SMALL ELONGATION IN INCOMPRESSIBLE FLOW**  
E N Nabyullin 27 Jan 1975 18 p refs. Transl into ENGLISH

from Uch Zap Tsentr Aerogidrodinamicheskii Inst (USSR), v 3, no 4, 1972 p 145-148

(AD-A007204, FTD-MT-24-0561-75) Avail NTIS CSCL 01/1  
Aerodynamic influences which define the aerodynamic rigidity of aircraft are considered as the sum of effects of aerodynamic forces. The Strouhal number is equal to zero, and the forces proportional to the Strouhal number are added to inertial forces. Other topics discussed include aerodynamic damping, delta wings, incompressible flow, and pressure distribution M J S

**N75-22297#** Technology, Inc., Dayton, Ohio  
**STRUCTURAL LOADS SURVEY DURING COLD-WEATHER OPERATIONS Final Report, Sep. 1973 - Sep 1974**  
Terry Z Cox and Thomas A Torres Feb 1975 185 p refs  
(Contract DAAJ02-74-C-0006, DA Proj 1F1-62208-AA-43)  
(AD-A007091, USAAMRDL-TR-75-3) Avail NTIS CSCL 01/3

To determine the effects of cold weather on the loads of dynamic components in the main and tail rotor systems of the UH-1H helicopter was the prime objective of the reported study. Accordingly, 18 hours of in-flight oscillograph data were recorded on these components while the helicopter flew at prescribed temperature-density altitude conditions in the arctic environment of Allen Army Airfield, Fort Greely, Alaska, during January and February of 1974. Equipped with strain gages, the instrumented components were the main and tail rotor blades, drag brace, scissors link, collective and cyclic boost tubes, and tail rotor shaft GRA

**N75-22301\*#** Douglas Aircraft Co., Inc., Santa Monica, Calif  
**ANALYSIS OF OPERATIONAL REQUIREMENTS FOR MEDIUM DENSITY AIR TRANSPORTATION, VOLUME 2 Final Report**  
Mar 1975 388 p refs  
(Contract NAS2-8135)  
(NASA-CR-137604, MDC-J4484-Vol-2) Avail NTIS  
HC \$10 25 CSCL 01C

The medium density air travel market is examined and defined in terms of numbers of people transported per route per day and frequency of service. The operational characteristics for aircraft to serve this market are determined and a basepoint aircraft is designed from which tradeoff studies and parametric variations can be conducted. The impact of the operational characteristics on the air travel system is evaluated along with the economic viability of the study aircraft. Research and technology programs for future study consideration are identified. J M S

**N75-22302\*#** Douglas Aircraft Co., Inc., Santa Monica, Calif  
**ANALYSIS OF OPERATIONAL REQUIREMENTS FOR MEDIUM DENSITY AIR TRANSPORTATION VOLUME 3 APPENDIX**  
Mar 1975 277 p  
(Contract NAS2-8135)  
(NASA-CR-137605, MDC-J4484-Vol-3) Avail NTIS  
HC \$8 75 CSCL 01C

For abstract see N75-22301

**N75-22303#** Boeing Vertol Co., Philadelphia Pa  
**CRASHWORTHY TROOP SEAT INVESTIGATION Final Report**  
Mason J Reilly Dec 1974 336 p refs  
(Contract DAAJ02-72-C-0077, DA Proj 1F1-62205-A-529)  
(AD-A007090, D210-10778-4, USAAMRDL-TR-74-93) Avail NTIS CSCL 01/3

The purpose of this investigation was to perform a research program for the development, analytical verification, mockup evaluation, and comparison of designs for practical crashworthy forward-, aft- and side-facing troop seating systems for U.S. Army helicopters. Tasks performed during the program included a literature survey, military organization survey, and questionnaire distribution to obtain data on existing seats, restraint systems, accommodation and human factors requirements, mathematical simulation of crash force attenuation, and energy attenuator development. These data were used in developing 19 crashworthy troop seat concepts and several restraint systems applicable to troop use GRA

**N75-22304#** Air Force Logistics Command, Wright-Patterson AFB, Ohio

**AN OPERATIONAL FIRE HAZARDS ANALYSIS OF THE C-5**  
Feb 1975 151 p  
(AD-A007072) Avail NTIS CSCL 01/3

The objective established for the study was to identify potential fire hazards in the C-5. A potential fire hazard may be identified as any area containing both an ignition source and a combustible material. The C-5, as any aircraft, contains the combustibles (such as hydraulic fluid and JP-4) and ignition sources (such as electrical/electronic components and wiring, hot surfaces, hydraulic motors, actuators, and highspeed rotating components) necessary for fire initiation, i.e., potential fire hazards. GRA

**N75-22305#** Technology, Inc., Dayton, Ohio  
**A FEASIBILITY STUDY FOR MONITORING SYSTEMS OF FATIGUE DAMAGE TO HELICOPTER COMPONENTS Final Report, Mar. 1973 - Aug 1974**  
R B Johnson, G L Martin, and M S Moran Jan 1975 194 p refs  
(Contract DAAJ02-73-C-0053)  
(AD-A006641, USAAMRDL-TR-74-92) Avail NTIS CSCL 01/3

The report describes efforts to monitor and record the in-flight operations of UH-1H and CH-47C helicopters for the subsequent assessment of the fatigue damage to their structures, four types of monitoring were investigated: (1) flight condition monitoring, (2) component-load monitoring, (3) mission-type monitoring, and (4) direct monitoring. After the recording systems and corresponding data processing systems were identified for each monitoring type, each type was tested for its technical acceptability and cost-effectiveness. Study results indicated that the flight condition monitoring is best for the UH-1H and also for the CH-47C provided that the monitoring of gross weight for the latter model becomes technically acceptable. GRA

**N75-22306#** Air Force Inst of Tech., Wright-Patterson AFB, Ohio School of Systems and Logistics  
**THE POTENTIAL OF AN 8 X 8 X 5 FEET INTERMODAL CONTAINER AS A UNITIZATION MEDIUM FOR ROUTINE MILITARY AIR CARGO M S Thesis**  
Michael M Rice and Dennis E Welch Jan 1975 236 p refs  
(AD-A006675, SLSR-23-75A) Avail NTIS CSCL 15/5

This study addressed one of the factors which affect the use of intermodal containers for air cargo shipments, the relationship between the size and quantity of the air cargo to be shipped and the size of the intermodal container. The cargo data used in the study were extracted from records of air shipments from Dover AFB, Delaware to Rhein Main and Ramstein AFBs for the third quarter of FY 1974. The container used in the study was a proposed 8 ft x 8 ft x 5 ft intermodal QUADCON container. The overseas transportation network used in the study consisted of one CONUS APOE, one overseas APOD, and nine cargo break-bulk point destinations. Several computer programs and a GE 600 series computer were used to manipulate the cargo data. GRA

**N75-22307** Kansas Univ., Lawrence  
**AN INVESTIGATION OF AIR TRAFFIC CONTROL PROCEDURES AND PILOT TECHNIQUES IN A HIGH DENSITY TERMINAL AREA Ph D Thesis**  
Charles Edward Knox 1974 389 p  
Avail Univ Microfilms Order No 75-6149

An investigation was conducted to determine if increases in runway capacity could be achieved through the modification of various air traffic control procedures and pilot techniques. Modified procedures and techniques were to be specified such that equipment not already necessary for IFR and/or VFR flight in a high density, semi-positive controlled airspace would not be required. A summary of pertinent pilot and air traffic controller constraints and airspace structure around the high density terminal area and a review of wake vortex characteristics and avoidance procedures was included in this investigation. Kinematic equations of motion and aircraft performance equations were developed for take-off, landing, and in-flight maneuvering computations. The

landing only runway capacity investigation was conducted as a parametric trade-off study, with runway capacity as the dependent variable. Parametric plots as a function of approach speed were drawn with operations per hour as the result. This procedure allowed quick and simple calculations to be performed that showed relative runway capacity changes due to parametric changes resulting from technique and procedural modifications.

Dissert Abstr

**N75-22313\*#** National Aeronautics and Space Administration  
Ames Research Center, Moffett Field Calif  
**FACTORS AFFECTING HANDLING QUALITIES OF A  
LIFT-FAN AIRCRAFT DURING STEEP TERMINAL AREA  
APPROACHES**

Ronald M Gerdes and Charles S Hynes Apr 1975 26 p  
refs  
(NASA-TM-X-62424, A-6016) Avail NTIS HC \$3 75 CSCL  
01C

The XV-5B lift-fan aircraft was used to explore the factors affecting handling qualities in the terminal area. A 10 deg ILS approach task was selected to explore these problems. Interception of the glide slope at 457.2 m, glide slope tracking, deceleration along the glide slope to a spot hover were considered. Variations in airplane deck angle, deceleration schedule, and powered-lift management were studied. The overall descent performance envelope was identified on the basis of fan stall, maximum comfortable descent rate, and controllability restrictions. The collective-lift stick provided precise glide slope tracking capability. The pilot preferred a deck-parallel attitude for which he used powered lift to control glide slope and pitch attitude to keep the angle of attack near zero. Workload was reduced when the deceleration schedule was delayed until the aircraft was well established on the glide slope since thrust vector changes induced flight path disturbances.

Author

**N75-22314\*#** McDonnell-Douglas Corp., Long Beach Calif  
**BORON/ALUMINUM SKINS FOR THE DC-10 AFT PYLON**  
**Final Report, 28 Feb. - 31 Oct 1974**

S Y Elliott May 1975 150 p refs  
(Contract NAS1-13029)  
(NASA-CR-132645) Avail NTIS HC \$5 75 CSCL 01C

Boron/aluminum pylon boat tail skins were designed and fabricated and installed on the DC-10 aircraft for a 5-year flight service demonstration test. Inspection and tests of the exposed skins will establish the ability of the boron/aluminum composite to withstand long time flight service conditions, which include exposure to high temperatures, sonic fatigue, and flutter. The results of a preliminary testing program yield room temperature and elevated temperature data on the tension compression, in-plane shear, interlaminar shear, bolt bearing, and tension fatigue properties of the boron/aluminum laminates. Present technology was used in the fabrication of the skins. Although maximum weight saving was not sought, weight of the constant thickness boron/aluminum skin is 26% less than the chemically milled titanium skin.

Author

**N75-22315#** Calspan Corp., Buffalo, N Y  
**A TWO-PHASE INVESTIGATION OF LONGITUDINAL  
FLYING QUALITIES FOR FIGHTERS PHASE 1. THE  
EFFECT OF EVALUATION TECHNIQUE AND FLIGHT PHASE  
ON FLYING QUALITIES ASSESSMENT PHASE 2. AN  
EXAMPLE OF CRITERIA DEVELOPMENT, CONTROL  
SYSTEM DESIGN AND FLIGHT TEST EVALUATION OF  
FOUR CONTROL SYSTEMS USING Eta-2, ALPHA, AND q  
FEEDBACK. Final Report, 1 Feb. - 14 Dec 1972**

Edward M Boothe, Robert T N Chen, and Charles R Chalk  
Apr 1974 291 p refs  
(Contract F33615-73-C-3051)  
(AD-782218, CALSPAN-AK-5280-F-2, AFFDL-TR-74-9) Avail  
NTIS CSCL 01/2

A two-phase study was performed using the USAF NI-33 A variable stability airplane. In Phase 1 of the study the effect of the evaluation technique used in the assessment of airplane flying qualities for the air combat flight phase was investigated. In-flight evaluations with and without a target airplane were performed for selected configurations from

AFFDL-TR-70-74. The results from the evaluations with a target airplane were compared to results obtained with a target airplane and to the results in AFFDL-TR-70-74. In all cases the evaluations performed without a target airplane were adequate to reveal potential flying qualities problems in the detailed pilot comments. There was however larger variability in the rating differences between the evaluations performed with and without a target. There were also significant rating differences between the evaluations performed with and without a target for about 15% of the configurations. (Modified author abstract) GRA

**N75-22316#** Air Force Systems Command, Wright-Patterson  
AFB Ohio Foreign Technology Div

**THE FATE OF THE WINGED METAL**

F Kvasov, A Tumanov, and I Fridlyander 3 Jan 1975 16 p  
refs Transl into ENGLISH from Literaturnaya Gazeta (USSR),  
no 24, 12 Jun 1974 p 11  
(AD-A006843 FTD-HT-23-204-75) Avail NTIS CSCL 01/3

The translation briefly touches on a few highlights in the history of aircraft construction since 1924 to the present. GRA

**N75-22317#** Kaman Aerospace Corp., Bloomfield, Conn  
**ARMY AIRCRAFT SUBSYSTEM AND COMPONENT  
INSTALLATION DESIGN INVESTIGATION Final Report, Jun  
1973 - Aug 1974**

Thomas N Cook, Frank E Stares, and George W Haire Feb  
1975 192 p  
(Contract DAAJ02-73-C-0082, DA Proj 1F2-62203-AH-86)  
(AD-A007245 USAAFMRDL-TR-75-7) Avail NTIS CSCL  
01/3

This report examines the design of major component installations in current inventory helicopters and its effect on the man-hours required to replace these components. Recommendations are developed for improving the maintainability of future aircraft through state-of-the-art applications and new design concepts. GRA

**N75-22318\*#** National Aeronautics and Space Administration  
Langley Research Center, Langley Station, Va  
**A MODEL AND PLAN FOR A LONGITUDINAL STUDY OF  
COMMUNITY RESPONSE TO AIRCRAFT NOISE**

Walter J Gunn, Harold P Patterson (Tracor, Inc., Austin Tex),  
June Cornog (NBS, Gaithersburg, Md), Patricia Klaus (NBS,  
Gaithersburg, Md), and William K Connor (Tracor Inc., Austin  
Tex) Apr 1975 104 p refs  
(NASA-TM-X-72690) Avail NTIS HC \$5 25 CSCL 20A

A new approach is discussed for the study of the effects of aircraft noise on people who live near large airports. The approach was an outgrowth of a planned study of the reactions of individuals exposed to changing aircraft noise conditions around the Dallas-Ft. Worth (DFW) regional airport. The rationale, concepts, and methods employed in the study are discussed. A critical review of major past studies traces the history of community response research in an effort to identify strengths and limitations of the various approaches and methodologies. A stress-reduction model is presented to provide a framework for studying the dynamics of human response to a changing noise environment. The development of the survey instrument is detailed and preliminary results of pretest data are discussed. Author

**N75-22319\*#** Kanner (Leo) Associates, Redwood City, Calif  
**ANALYSIS OF THE VELOCITY DISTRIBUTION AT THE  
BLADE TIPS OF AXIAL-FLOW COMPRESSORS**

H Ufer Washington NASA May 1975 27 p Transl into  
ENGLISH from Tech Mitt Krupp, Forschungsber (West  
Germany), v 26, no 2, Oct 1968 p 33-45  
(Contract NASw-2481)  
(NASA-TT-F-16366) Avail NTIS HC \$3 75 CSCL 21E

Velocity distribution at the blade tips of axial-flow compressors is analyzed on the basis of measurements and calculations. It is found that clearance flow has direct effect on flow at blade tips as well as indirect effect on flow as far as the hub. Good qualitative agreement was found between flow at stationary rectilinear cascades and at rotating cascades. Author

**N75-22320\*** Rockwell International Corp., Los Angeles, Calif  
**TESTING OF LIFT/CRUISE FAN EXHAUST DEFLECTOR**  
 Donald W Schlundt Mar 1975 68 p  
 (Contract NAS2-7657)  
 (NASA-CR-137682, NA-75-227) Avail NTIS HC \$4.25 CSCL 21E

A lift/cruise exhaust deflector system for the LF336/A tip turbine lift fan was designed, built, and tested to determine the design and performance characteristics of a large-scale, single swivel nozzle thrust vectoring system. The exhaust deflector static testing was performed at the Ames Research Center outside static test stand facilities. The test hardware was installed on a hydraulic lift platform to permit both in and out of ground effect testing. The exhaust flow of the LF336/A lift fan was vectored from 0 degrees through 130 degrees during selected fan speeds to obtain performance at different operating conditions. The system was operated with and without flow vanes installed in the small radius bends to evaluate the system performance based on a proposed method of improving the internal flow losses. The program also included testing at different ground heights, to the nozzle exhaust plane, to obtain ground effect data and the testing of two methods of thrust spoiling using a duct bypass door system and nozzle flap system. Author

**N75-22323\*** AirResearch Mfg Co. Phoenix Ariz  
**STUDY OF SMALL CIVIL TURBOFAN ENGINES APPLICABLE TO MILITARY TRAINER AIRPLANES** Final Report  
 R W Heldenbrand G L Merrill, and G A Burnett Apr 1975 138 p refs  
 (Contract NAS2-6799)  
 (NASA-CR-137575, AirResearch-74-210987-a) Avail NTIS HC \$5.75 CSCL 21E

Small turboprop engine design concepts were applied to military trainer airplanes to establish the potential for commonality between civil and military engines. Several trainer configurations were defined and studied. A "best" engine was defined for the trainer mission, and sensitivity analyses were performed to determine the effects on airplane size and efficiency of wing loading, power loading, configuration, aerodynamic quality, and engine quality. It is concluded that a small civil aircraft is applicable to military trainer airplanes. Aircraft designed with these engines are smaller, less costly, and more efficient than existing trainer aircraft. Author

**N75-22325\*** General Electric Co., Cincinnati, Ohio  
**EXPERIMENTAL QUIET ENGINE PROGRAM** Summary Report  
 W G Cornell Washington NASA Mar 1975 127 p refs  
 (Contract NAS3-12430)  
 (NASA-CR-2519, R74AEG307) Avail NTIS HC \$5.75 CSCL 21E

Full-scale low-tip-speed fans, a full-scale high-tip-speed fan, scale model versions of fans, and two full-scale high-bypass-ratio turboprop engines, were designed, fabricated, tested, and evaluated. Turbine noise suppression was investigated. Preliminary design studies of flight propulsion system concepts were used in application studies to determine acoustic-economic tradeoffs. Salient results are as follows: tradeoff evaluation of fan tip speed and blade loading, systematic data on source noise characteristics and suppression effectiveness, documentation of high- and low-fan-speed aerodynamic and acoustic technology, aerodynamic and acoustic evaluation of acoustic treatment configurations, casing tip bleed, serrated and variable pitch rotor blades, leaned outlet guide vanes, slotted tip casings, rotor blade shape modifications, and inlet noise suppression, systematic evaluation of aerodynamic and acoustic effects, flyover noise projections of engine test data, turbine noise suppression technology development, and tradeoff evaluation of preliminary design high-fan-speed and low-fan-speed flight engines. Author

**N75-22326\*** Advisory Group for Aerospace Research and Development Paris (France)  
**SECONDARY POWER SYSTEMS FOR ADVANCED ROTORCRAFT**  
 Raymond G Smith (Boeing Vertol Co. Phila. Pa.) Feb 1975

94 p refs  
 (AGARD-AG-206, AGARDograph-206) Avail NTIS HC \$4.75  
 The results are presented of a review of European manufactured Secondary Power Systems (SPS) for rotorcraft. A compilation of SPS functions, parametric SPS component data for optimization trade studies, and a trade study to select an optimum SPS are presented. The study addresses the aspects of integrated SPS (electrical, hydraulic, pneumatic, and mechanical) concepts for cockpit and avionics environmental control systems, ice protection system, hoist drive system, main engine starting, auxiliary power unit, and its starting system integration. System optimization and recommended selection are based on trade study parameters of weight, cost, and product assurance. Author

**N75-22328\*** Hughes Helicopters, Culver City, Calif  
**OH-6A PROPULSION SYSTEM VIBRATION INVESTIGATION** Final Report, 27 Nov. 1972 - 15 Jun 1974  
 R J Sullivan R E Head G J Korkosz, J R Neff, and S J Soltis Jan 1975 216 p refs  
 (Contract DAAJ02-73-C-0016, DA Proj 1G1-62204-AA-72)  
 (AD-A007225, Rept-369-V-8009(HH-74-114), USAAMRDL-TR-74-85) Avail NTIS CSCL 01/3

A study was made of means to improve helicopter engine/airframe vibratory interface compatibility. The study was based on the characteristics of the OH-6A helicopter and the T63 engine in order to utilize existing data to validate the methodology produced in the study. Available engine and airframe data was reviewed and used to prepare a vibration spectrum for a typical mission. Airframe mobility data was acquired during a ground shake test. A finite element model of the OH-6A airframe was prepared and was coupled to a model of the T63 engine which was based on mobility data supplied by the engine manufacturer. The airframe and engine models were combined using a modal coupling technique, and reasonable correlation with test data was obtained. An impedance/mobility coupling technique is recommended where many flexible modes are in the frequency ranges that could be excited by main-rotor-induced vibratory forces. Based on the study, recommendations were prepared and circulated to engine manufacturers for future engine vibration specification, vibration parameter selection, and data reduction. The results of the survey and the proposed recommendations are presented. GRA

**N75-22329\*** McDonnell Aircraft Co., St. Louis, Mo  
**ANALYSIS AND SIMULATION OF VARIABLE THROTTLE/ENERGY MANAGEMENT CONCEPTS FOR FIGHTER AIRCRAFT** Final Report, 29 Jun 1973 - 1 Oct 1974  
 G G Grose, R J Landy, R G Marsh, and R D Turner Nov 1974 152 p refs  
 (Contract F33615-73-C-3130, AF Proj 1987)  
 (AD-A006745, AFFDL-TR-74-138) Avail NTIS CSCL 01/3

The application of a modified Rutowski logic to mission throttle/energy management was extended, investigating additional types of mission segments and providing a means of logically integrating optimum segments into mission profiles. Measurable fuel savings through throttle modulation were predicted for a demonstration flight mission for the F-4E airplane. A flight path and throttle control system was designed for following the optimum paths. A hybrid simulation plan was prepared. GRA

**N75-22330\*** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div  
**JET ENGINE THEORY (TURBOMACHINES), SELECTED CHAPTERS**  
 B S Stechkin and P K Kazandzhan 22 Jan 1975 308 p refs  
 Transl. into ENGLISH from the book "Teoriya Reaktivnykh Dvigateli Lopatochnye Mashiny" 1956, p 34-56, 125-339, 545-548  
 (AD-A007175, FTD-HC-23-0086-75) Avail NTIS CSCL 21/5

This book is intended for students of the aviation institutes and may be useful for scientific personnel and engineers working in the gas turbine engine field. It presents theory, design methods, and flow passage component profiling techniques, and examines the characteristics of compressors and turbines used in turbojet

and turboprop engines The authors have also used the literature available on rotor, stator and jet engine theory GRA

**N75-22331#** General Motors Corp., Indianapolis, Ind Detroit Diesel Allison Div

**T63 ENGINE VIBRATORY CHARACTERISTICS ANALYSIS Final Report, Dec 1973 - Mar 1974**

W H Parker Jan 1975 215 p refs

(DA Proj 1G1-62204-AA-72)

(AD-A007243 DDA-EDR-8177 USAAMRDL-TR-74-87) Avail NTIS CSCL 21/5

A study of the T63-A-5 engine vibratory environment installed in the OH-58 and OH-6 light observation helicopters is presented in this report The purpose of the study is to develop a common language for use in engine/airframe (translational) vibration specifications and analyses related to future helicopter programs Mobility and modal synthesis techniques for coupled dynamic system analyses are developed These techniques are then applied to the aforementioned helicopter systems for evaluation GRA

**N75-22332** Kansas Univ., Lawrence

**SOME METHODS FOR ANALYZING AIRCRAFT WITH LINEAR AUTOMATIC CONTROL SYSTEMS Ph D Thesis**

Samuel Arthur Henry 1974 389 p

Avail Univ Microfilms Order No 75-6193

Methods are presented for calculating the transfer functions for the response to control and disturbance inputs of aircraft with linear automatic control systems, and for determining the variance of aircraft and control surface motions in standard turbulence fields Transfer functions of the aircraft with automatic controls are derived by incorporating the control system feedback path transfer functions into the Laplace-transformed, linear, small perturbation equations of motion for the aircraft and solving the equations by matrix methods Algebraic and digital numerical solutions are presented The aircraft and control surface motion variances are derived from standard turbulence power density spectra by using linear filtering techniques to obtain the aircraft motion spectra and the control deflection spectra, which are integrated numerically to obtain the variances Dissert Abstr

**N75-22333** Kansas Univ., Lawrence

**A SEPARATE SURFACE STABILITY AUGMENTATION SYSTEM FOR A GENERAL AVIATION AIRPLANE Ph D Thesis**

Willard R Bolton Jr and Donald Joe Collins 1974 300 p

Avail Univ Microfilms Order No 75-6147

This report describes a design and development project undertaken to provide the benefits of full-time stability augmentation at a cost low enough to encourage application in general aviation aircraft With attitude command the automatic control system maintains aircraft attitude proportional to pilot control deflection despite disturbances such as atmospheric turbulence Proposed aircraft modifications to achieve attitude command require subdividing each existing aerodynamic control surface into a pilot cable controlled segment, and a separate automatically controlled segment actuated by an electromechanical actuator These separate surfaces when used for stability augmentation provide these benefits (1) elimination of undesirable force feedback through pilot controls (2) simple retrofit to existing aircraft or incorporation into new designs (3) minimum hazards in failed states, and (4) low cost through the elimination of control system redundancy Dissert Abstr

**N75-22334\*#** General Electric Co., Pittsfield Mass Environmental Electromagnetics Unit

**LIGHTNING EFFECTS ON THE NASA F-8 DIGITAL-FLY-BY-WIRE AIRPLANE Final Report**

J A Plumer, F A Fisher, and L C Walko Washington NASA Mar 1975 154 p refs

(Contract NAS4-2090)

(NASA-CR-2524, SRD-26-06) Avail NTIS HC \$6 25 CSCL 01C

The effects of lightning on a Digital Fly-By-Wire (DFBW) aircraft control system were investigated The aircraft was a NASA operated F-8 fitted with a modified Apollo guidance computer Current pulses similar in waveshape to natural lightning, but lower in amplitude, were injected into the aircraft Measurements were made of the voltages induced on the DFBW circuits, the total current induced on the bundles of wires, the magnetic field intensity inside the aircraft, and the current density on the skin of the aircraft Voltage measurements were made in both the line-to-ground and line-to-line modes Voltages measured at the non-destructive test level were then scaled upward to determine how much would be produced by actual lightning A 200,000 ampere severe lightning flash would produce between 40 and 2000 volts in DFBW circuits Some system components are expected to be vulnerable to these voltages Author

**N75-22336#** Harry Diamond Labs., Washington D C

**PRECISION LINEAR FLIGHT**

Dennis R Cook Sep 1974 19 p

(AD-A007134, HDL-TM-74-16) Avail NTIS CSCL 01/3

An instrumentation system is described that enables a jet aircraft to maintain a linear high-angle dive path at constant speed The density and motion of the air, as well as the mass thrust, and drag configuration of the aircraft affect the performance of an aircraft diving toward a fixed point on the ground Standard airborne instrumentation is insufficient to maintain a plus or minus one deg course and a plus or minus ten percent ground speed in a 30-deg dive It was demonstrated in a series of test dives at various fixed angles that, by using ground based instrumentation, how these precisions could be attained over portions of the dive GRA

**N75-22340#** Naval Air Development Center, Warminster, Pa Air Vehicle Technology Dept

**PROGRAM PLAN FOR INVESTIGATION OF MODEL S-2 AIRPLANE CATAPULT AND HOLD BACK OPERATIONS CAPACITY**

Henry Lystad 13 Feb 1975 27 p refs

(AD-A006892 NAD-75014-30) Avail NTIS CSCL 01/3

A laboratory fatigue test will be performed on an S-2 airframe to determine whether the airframe will sustain the effects of 3,000 catapult launches without structural failure GRA

**N75-22441#** Cincinnati Univ., Ohio Dept of Aerospace Engineering

**AN EXPERIMENTAL INVESTIGATION OF THE PARTICLE DYNAMICS OF QUARTZ SAND IMPACTING 6Al-4V TITANIUM AND 410 STAINLESS STEEL IN AN EROSION ENVIRONMENT**

R Ball and W Tabakoff Oct 1974 39 p refs

(Contract DAHC04-69-C-0016)

(AD-A007213, ARO-T-4-67-E, Rept-74-43) Avail NTIS CSCL 11/6

The impact and rebound characteristics of high speed erosive quartz particles have been experimentally determined The impact parameters were found to be statistical in nature and the statistical distributions were obtained The alloys used in this investigation were 410 stainless steel and 6Al-4V Because of the increased usage and interest in vehicles which operate on and over unprepared and dusty terrains (helicopters hovercraft and V/STOL aircraft), recent interest in this field is involved with the prediction of erosion in aero turbomachinery GRA

**N75-22487#** Advisory Group for Aerospace Research and Development, Paris (France)

**SPECIALISTS MEETING ON FRETTING IN AIRCRAFT SYSTEMS**

Jan 1975 229 p refs In ENGLISH, partly in FRENCH Presented at 39th Meeting of the Struct and Mater Panel Munich 6-12 Oct 1974

(AGARD-CP-161) Avail NTIS HC \$7 50

The effects of fretting and wear on the reliability of aircraft structures and engines are examined Various control surfaces



are categorized in terms of their role in the maintenance of flight profile and structural integrity along with several typical fretting situations. The occurrence of fretting on the fan, compressor, and turbine blades of jet engines is examined to include the effects on splines, rolling elements, bearing races, and secondary sealing elements of face type seals. The sequence of events which constitute the fretting mechanism is analyzed.

**N75-22488** Missouri Univ. Columbia Coll. of Engineering  
**FRETTING OF AIRCRAFT CONTROL SURFACES**  
 David W. Hoepfner / In AGARD Specialists Meeting on Fretting in Aircraft Systems Jan 1975 9 p Sponsored in part by ONR (For availability see N75-22487 14-31)

The occurrence of fretting and fretting fatigue in aircraft structures and components is discussed. The terminology and general conditions which produce fretting are defined. The two major elements of the fretting process are identified as: (1) relative displacement between surfaces in contact and (2) a normal load acting upon the surfaces. The conditions which lead to an acceleration of fretting and wear are analyzed. Illustrations of fretting fatigue and damage to representative aircraft components are provided. Author

**N75-22489** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany)

**FRETTING OF STRUCTURES FOR MODERN VG FIGHTERS**

Volker Vontein and Peter E. Seibert / In AGARD Specialists Meeting on Fretting in Aircraft Systems Jan 1975 15 p refs

The fretting phenomenon of structures for fighter aircraft and practical countermeasures to reduce fretting are discussed. Fretting problems caused by wing pivots are examined. The layout and design of the pivot lugs and bearings to avoid fretting are shown. A description of a wing carry-through box for fretting reduction is included. Author

**N75-22490** Westland Helicopters, Ltd., Yeovil (England)  
**FRETTING IN HELICOPTERS**

J. R. Lee / In AGARD Specialists Meeting on Fretting in Aircraft Systems Jan 1975 10 p

The fretting problem in helicopters which is created by the high frequency of alternating loads is discussed. Examples are given of some of the more common cases of fretting. The most serious effect of fretting is stated to be reduction in fatigue strength. Methods for alleviating fretting by clamping pressure to prevent relative movement, improved lubrication, soft low strength interlayers, and hard wear resistant coatings are proposed. The author states that in many cases the only method for eliminating or reducing fretting is to redesign the component. Author

**N75-22491** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft

**FRETTING FATIGUE IN TITANIUM HELICOPTER COMPONENTS**

M. J. Salkind / In AGARD Specialists Meeting on Fretting in Aircraft Systems Jan 1975 6 p refs

An analysis of the effects of fretting on the fatigue strength of titanium components used in helicopters is presented. Methods for reducing the effects of fretting consist of cold working of contact surfaces, silver plating, solid lubricants, and sacrificial metallic liners. Electron micrographs of main fracture surface for typical components are shown. The need for full scale testing to establish fretting characteristics is stressed since there are no representative small specimen tests which duplicate the fretting mechanism and the parameters controlling it. Author

**N75-22492#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

**FRETTING IN AIRCRAFT TURBINE ENGINES**

Robert L. Johnson and Robert C. Bill / In AGARD Specialists Meeting on Fretting in Aircraft Systems Jan 1975 17 p refs

Prepared in cooperation with Army Air Mobility R and D Lab., Cleveland

The problems created by fretting in turbine engines are discussed. The areas of greatest wear identified with the fan, compressor, and turbine blade mountings being the most critical items. Various methods for reducing or eliminating fretting in a turbine engine are described. Vacuum deposition of coatings by sputtering and ion plating are recommended as an economic method of applying thin films to inhibit fretting. Author

**N75-22493** Societe Nationale d'Etudes et de Construction de Moteurs Aeronautiques, Corbeil (France)

**COMMENT ON WEAR OF NON-LUBRICATED PIECES IN TURBOMACHINES [COMMENT REDUIRE L'USURE DES PIECES NON LUBRIFIEES DANS LES TURBOMACHINES]**

J. Thiery and R. Spinat / In AGARD Specialists Meeting on Fretting in Aircraft Systems Jan 1975 14 p In FRENCH, ENGLISH summary

The parts of a turbojet engine which may be damaged by fretting are identified. Fretting wear is investigated on an alternate friction test rig up to high temperatures for various solid materials and a number of anti-wear skins. From the results obtained, behavior principles for materials and skins are derived and used as guidelines to solve the main wear problems encountered. Author

**N75-22506** Liege Univ. (Belgium) Lab. des Techniques Aeronautiques et Spatiales

**RECENT PROGRESS IN THE ANALYSIS OF STRUCTURES USING THE FINITE ELEMENT METHOD [RECENTS PROGRES DANS L'ANALYSE DES STRUCTURES PAR LA METHODE DES ELEMENTS FINIS]**

G. Sander / In ESRO Large Struct. for Manned Spacecraft Mar 1974 p 15-42 refs In FRENCH

Main activities of the university in the field of structural analysis and continuous media analysis using the finite element method are reviewed, as well as difficulties encountered in application of the finite element method to the analysis of large dimension structures. Dual analysis principles, characteristics and performances are discussed. Computer programs for dynamic analysis of structures are presented, and applications to some cases including the static analysis of VFW 614 aircraft flaps, dynamic analysis of flutter conditions of thermal protection panel, and dynamic analysis of Eole structures, are discussed. ESRO

**N75-22512** Marshall of Cambridge (Engineering) Ltd. (England)  
**THE APPLICATION AND DEVELOPMENT OF AIRCRAFT STRUCTURAL TECHNOLOGY (SAFETY ETC.)**

N. A. J. Harry / In ESRO Large Struct. for Manned Spacecraft Mar 1974 p 131-166

Methods and techniques applicable to aircraft structural safety, reliability, and airworthiness, with particular reference to the Spacelab element of the Post-Apollo program, are described. Derivation of safety factors for static and dynamic loads, the fatigue-prediction and fatigue-monitoring procedures, are examined and developed. Design criteria are formulated and consideration is given to effects of thermal cycling. Methods of structural analysis to determine stress levels and structural deformation characteristics are described. Particular design problems are discussed with comments on the effects of jointing and construction methods. Internal structure and systems-installation effects on the primary structure are examined and recommendations given. Fail-safe applications and crack propagation are described. Structural-testing practices, the number of models and application of static dynamic and fatigue-testing methods are presented, together with recommendations on pressure testing. Fatigue-testing procedures, correlation with fatigue-monitoring program and fatigue life estimation are prescribed. Methods of handling and analyzing test data are defined. Finally, the application of statistical methods to failure analysis is briefly outlined. Author (ESRO)

**N75-22516** Boeing Co., Seattle Wash  
**APPLICATION OF AEROSPACE STRUCTURES TO LARGE MANNED SPACECRAFT**

G F Riley and H L Schumann /In ESRO Large Struct for Manned Spacecraft Mar 1974 p 199-219

An evolutionary approach was used in the design of some of today's large aerospace systems, such as the Saturn-5 launch vehicle and the Boeing 700-series airplanes. This design extension of proven systems minimizes the need for new technology and results in a highly reliable system at lowest program cost. Extension of the evolutionary approach from the manned rating of an airplane flying at 35 000 ft altitude to a manned spacecraft such as Spacelab could produce a substantial cost saving while maintaining space standard reliability. This is especially attractive since continuing emphasis will be given to achieving low cost systems for manned spacecraft.

Author (ESRO)

**N75-22518** Hawker Siddeley Dynamics Ltd., Stevenage (England)  
**THE DESIGN PHILOSOPHY OF A REUSABLE SPACE STRUCTURE**

J A Dickinson /In ESRO Large Struct for Manned Spacecraft Mar 1974 p 253-257

The philosophies used in the design of the Spacelab Pallet structure are highlighted. The Pallet has to provide a payload flexibility unique in space structures not only for individual flights but for re-use in potentially different modes. It is shown that the design philosophy is influenced by a background of aircraft and spacecraft design practices.

Author (ESRO)

**N75-22519** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany) Inst fuer Bauweisen- und Konstruktionsforschung  
**MECHANICAL PROPERTIES OF COMPOSITE MATERIALS AND DESIGN CONCEPTS FOR COMPOSITE STRUCTURES**

R Kochendoerfer, G Grueninger, and K Stellbrink /In ESRO Large Struct for Manned Spacecraft Mar 1974 p 259-281 refs

The payload to gross weight ratio of Spacelab is low. An attractive means of saving weight is to use fiber-reinforced materials in the structure. The mechanical properties of composites are considered, together with existing successful applications of these materials in aircraft structures for a multitude of flight-tested components. Some peculiarities to be taken into account in the design of structural elements when using composite materials are discussed.

Author (ESRO)

**N75-22527** Industrieanlagen-Betriebsgesellschaft mbH Ottobrunn (West Germany)  
**STRUCTURAL TEST PRINCIPLES FOR FULL SCALE AIRFRAMES AND THEIR APPLICATION TO THE SPACELAB TESTS**

G Bayerdoerfer /In ESRO Large Struct for Manned Spacecraft Mar 1974 p 387-394 refs

In the development of aircraft structures, a number of tests have become a more or less standard part of the test program. These tests are carried out in order to ensure the integrity of the airframe with respect to stiffness, static strength, dynamic behavior, and fatigue properties. The test specimens used for these tests are well defined and clearly separated.

Author (ESRO)

**N75-22529** Societe de Production et de Developpement Radio-Electrique, Paris (France)  
**NEW COMPUTERIZED EQUIPMENT FOR EXPERIMENTAL DETERMINATION OF DYNAMIC CHARACTERISTICS OF STRUCTURES**

J Perruchot /In ESRO Large Struct for Manned Spacecraft Mar 1974 p 398-402

The procedures used for the experimental determination of the dynamic characteristics of structures are discussed. The determination of the modal scheme of aerospace structures by means of the global harmonic vibration test is analyzed to show advantages over the purely theoretical or mixed process. The methods applied for this type of structural analysis when using a mini-computer and specialized software, as well as the overall system, are reported. Improvements in the process are suggested.

Author

**N75-22538** Office National d'Etudes et de Recherches Aerospatiales, Paris (France)  
**DYNAMIC CHARACTERISTICS OF STRUCTURES DETERMINED USING POINT EXCITATION VIBRATION TESTING**

[DETERMINATION DES CARACTERISTIQUES DYNAMIQUES D'UNE STRUCTURE A PARTIR D'UN ESSAI DE VIBRATIONS AVEC EXCITATION PONCTUELLE]

R Dat /In ESRO Large Struct for Manned Spacecraft Mar 1974 p 511-518 refs In FRENCH

Avail NTIS

A method is described which allows the determination of transfer function from a vibration test carried out using a single excitation force. This method is based on the theory of discrete linear systems and uses the least squares smoothing program in order to determine the parameter which best fits the measured transfer functions. The parameters defining the matrix of the transfer functions are obtained using the finite element method.

ESRO

**N75-22539** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany)  
**A SEMI-AUTOMATIC MODAL-SURVEY TEST TECHNIQUE FOR COMPLEX AIRCRAFT AND SPACECRAFT STRUCTURES**

E Breitbach /In ESRO Large Struct for Manned Spacecraft Mar 1974 p 519-528 refs

An improved test technique for determining the normal modes, normal frequencies, generalized masses, and generalized damping coefficients of complex structures are dealt with. It is shown how the normal modes can be isolated using a semi-automatic computer-controlled multipoint harmonic excitation. New procedures for measuring the coupled generalized damping matrix and the generalized masses by means of electronically simulated additional masses or stiffnesses are described. A control method for checking the orthogonality of the measured normal modes is presented.

Author (ESRO)

**N75-22562\*#** Scientific Translation Service, Santa Barbara, Calif  
**OPERATION CONTROL SYSTEM FOR AIRCRAFT**

K Busch and H Bruemmer Washington NASA May 1975 22 p. Transl into ENGLISH from German patent Auslegeschrift no 1623888, German class 42d 1/12 International class Gold, 5/39, Reference P1623888 3-52 (34694) 25 Oct 1967 9 p (Contract NASw-2483) (NASA-TT-F-16362) Avail NTIS HC \$3.25 CSCL 17B

A description is given of a German patent used for operational monitoring for aircraft, using the multiplex method of a large number of measurement transducers, producing the measured variables in the form of electrical output signals.

Author

**N75-22666#** Northrop Corp., Hawthorne, Calif Aircraft Div  
**CALCULATION ON UNSTEADY TWO-DIMENSIONAL SUPERSONIC FLOW BY THE METHOD OF CHARACTERISTICS**

Technical Report, Mar 1973 - Feb 1974  
 C W Chu, H C Kao and S Nadir Oct 1975 46 p refs  
 (Contract N00014-73-C-0237 NR Proj 061-213)  
 (AD-A006969, NOR-74-84) Avail NTIS CSCL 20/4

A method of characteristics for unsteady two-dimensional flow is presented herein. The method is applied to flow fields over a blunt-nosed airfoil in a supersonic free stream. The compatibility relation is derived first. Then the method of solution is pre-

sented Three types of numerical examples are presented and discussed The first type establishes the stability of the numerical scheme The second type consists of the unsteady flow fields over an NACA 0024 airfoil in harmonic lunging pulsating, and pitching motions The third type represents application to steady flow problems and includes the calculation of the flow field over an NACA 0009 airfoil at a low supersonic speed of free stream Mach 1.2 GRA

**N75-22749#** Advisory Group for Aerospace Research and Development Paris (France)  
**ADVANCED MANUFACTURING METHODS AND THEIR ECONOMIC IMPLICATIONS SOME PILOT PAPERS ON POWDER METALLURGY AND JOINING**  
 Mar 1975 112 p refs In ENGLISH, partly in FRENCH (AGARD-R-627) Avail NTIS HC \$5.25

A systematic examination of the field of advanced fabrication techniques is reported together with an analysis of the impact of these new procedures on costs Six papers, given before the AGARD Structures and Materials Panel in the spring and fall of 1974, are contained in this document These six papers explore the latest state-of-the-art and the potentials for future development of various methods of fabrication of aerospace hardware Analyzed in these papers are such areas as metal joining methods production techniques for dispersion-strengthened materials and various aspects of powder metallurgy The six papers contained in this report constitute a pilot effort by the Structures and Materials Panel to determine the direction of future work of the panel in this important field

**N75-22750** Air Force Materials Lab., Wright-Patterson AFB, Ohio Metals Branch  
**POWDER METALLURGY PRODUCTION PROCESSES**  
 Larry P. Clark In AGARD Advan Manuf Methods and their Econ Implications Mar 1975 18 p

A review of the current status of powder metallurgy (P/M) technology and its application to aircraft engines and recommendations of the Powder Metallurgy Seminar are discussed The state-of-the-art in powder production consolidation methods secondary operations and NDE is discussed for titanium aluminum and superalloy P/M products Also, a summary of pertinent United States Air Force manufacturing technology programs in P/M is presented Author

**N75-22753** Wiggins (Henry) and Co. Ltd., Hereford (England)  
**PRODUCTION OF SUPERALLOYS FROM POWDERS**  
 F. A. Thompson and D. L. Williams In AGARD Advan Manuf Methods and their Econ Implications Mar 1975 15 p refs

Powder metallurgical techniques are reported, when applied to superalloy production overcome many of the problems facing the alloy developers for materials to use in the critical high temperature regions of aircraft gas turbine engines It is shown not only do they overcome many technical problems but in the future the powder techniques have the potential to increase material yields and processing efficiency thus leading to reduced costs Author

**N75-22795** Princeton Univ., N.J.  
**ANALYSIS OF COMPLEX ELASTIC STRUCTURES BY A RAYLEIGH-RITZ COMPONENT MODES METHOD USING LAGRANGE MULTIPLIERS** Ph.D. Thesis  
 Larisse Rosentweig Klein 1974 287 p  
 Avail Univ Microfilms Order No. 75-6649

The free vibrations of elastic structures of arbitrary complexity are analyzed in terms of their component modes The method is based upon the use of the normal unconstrained modes of the components in a Rayleigh-Ritz analysis The continuity conditions are enforced by means of Lagrange Multipliers Examples of the structures considered are beams with nonuniform properties, airplane structures with high or low aspect ratio lifting surface components, the oblique wing airplane, and plate

structures The method is also applied to the analysis of modal damping of linear elastic structures Convergence of the method versus the number of modes per component and/or the number of components is discussed, the method is compared to more conventional approaches to ad hoc methods for some examples, and to experimental results  
 Dissert. Abstr.

**N75-22901\*#** TRW Systems, Redondo Beach, Calif  
**TECHNOLOGY ASSESSMENT OF PORTABLE ENERGY RDT AND P, PHASE 1 Executive Summary Report**  
 J. R. Spraul, comp. 7 Apr 1975 13 p  
 (Contract NAS2-8445)  
 (NASA-CR-137654) Avail NTIS HC \$3.25 CSCL 10A

A technology assessment of transportation energy research, development, technology, and production was undertaken to assess the technical economic, environmental, sociopolitical issues associated with transportation energy options, and to determine those courses of action impacting aviation and air transportation research and technology A technology assessment workshop was used to determine the problem statements that would be considered Study tasks are summarized along with the problem statements  
 M. J. S.

**N75-22913#** Defence Research Establishment Ottawa (Ontario)  
**NICKEL/CADMIUM AIRCRAFT BATTERIES. FLOAT CHARGE TEST**

Keiva Feldman and William A. LePage Oct 1974 30 p refs (AD-A002767, DREO-R-705) Avail NTIS CSCL 10/3

Manufacturers have been unable to supply nickel/cadmium aircraft batteries which could pass the float charge test specified in the Canadian Forces Specification CF-B-70 Battery behavior under the conditions of the test has therefore been investigated The batteries tested started into thermal runaway because oxygen generated at the nickel plate reached the cadmium plate and reacted exothermally with it Recommendations are made for battery improvement, with respect to type of separator material and how it should be wrapped around the plates Suggestions for modification of the float charge test are also made, so that it can be more useful in identifying those batteries which are best able to withstand floating at high temperatures Suggestions for improved screening of defective cells and for limiting the overcharge on board the aircraft are made  
 GRA

**N75-22941\*#** National Aeronautics and Space Administration  
 Lewis Research Center, Cleveland, Ohio  
**NOISE DATA FROM TESTS OF A 183 METER (6-FT.) DIAMETER VARIABLE-PITCH 12-PRESSURE-RATIO FAN (QF-9)**

Frederick W. Glaser, Joseph A. Wazyniak, and Robert Friedman  
 Washington Mar 1975 185 p refs  
 (NASA-TM-X-3187, E-8102) Avail NTIS HC \$7.00 CSCL 20A

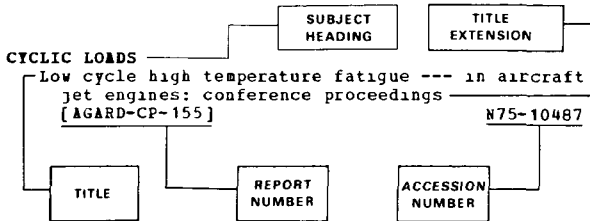
Acoustic and aerodynamic data for a 183-meter (6-ft.) diameter fan suitable for a quiet engine for short-takeoff-and-landing (STOL) aircraft are documented The QF-9 rotor blades had an adjustable pitch feature which provided a means for testing at several rotor blade setting angles, including one for reverse thrust The fan stage incorporated features for low noise Far-field noise around the fan was measured without acoustic suppression over a range of operating conditions for six different rotor blade setting angles in the forward thrust configuration, and for one in the reverse configuration Complete results of one-third-octave band analysis of the data are presented in tabular form Also included are power spectra, data referred to the source, and sideline perceived noise levels  
 Author

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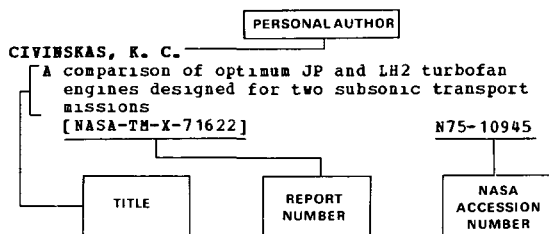
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