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A Continuing Bibliography with Indexes

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NASA SP-7037 (111)

AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 111

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 June 1979 in

- *Scientific and Technical Aerospace Reports (STAR)*
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This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 570 reports, journal articles, and other documents originally announced in June 1979 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

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

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

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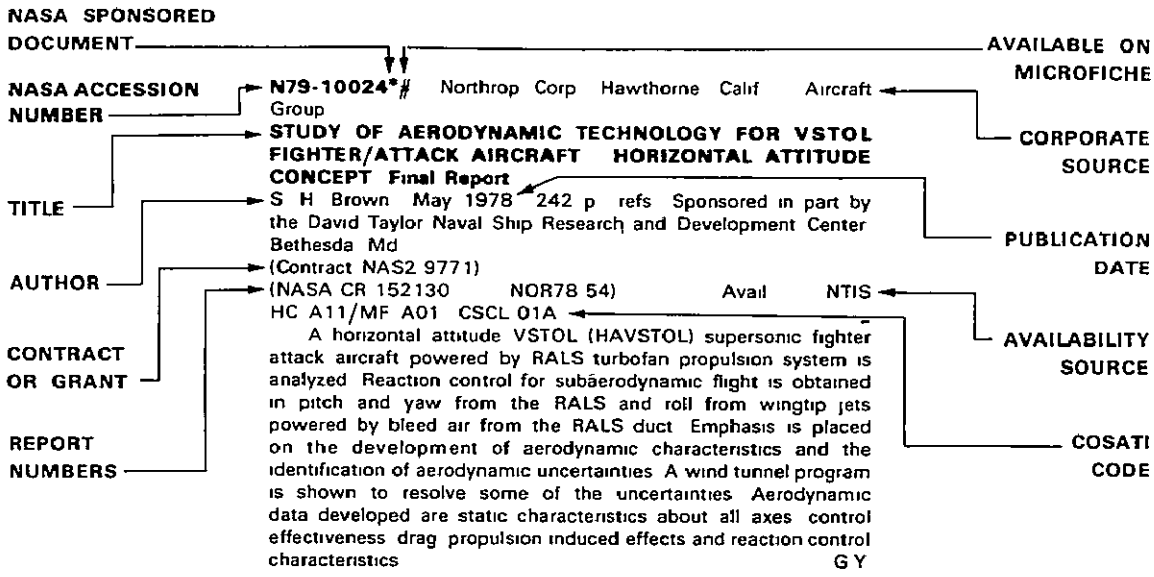

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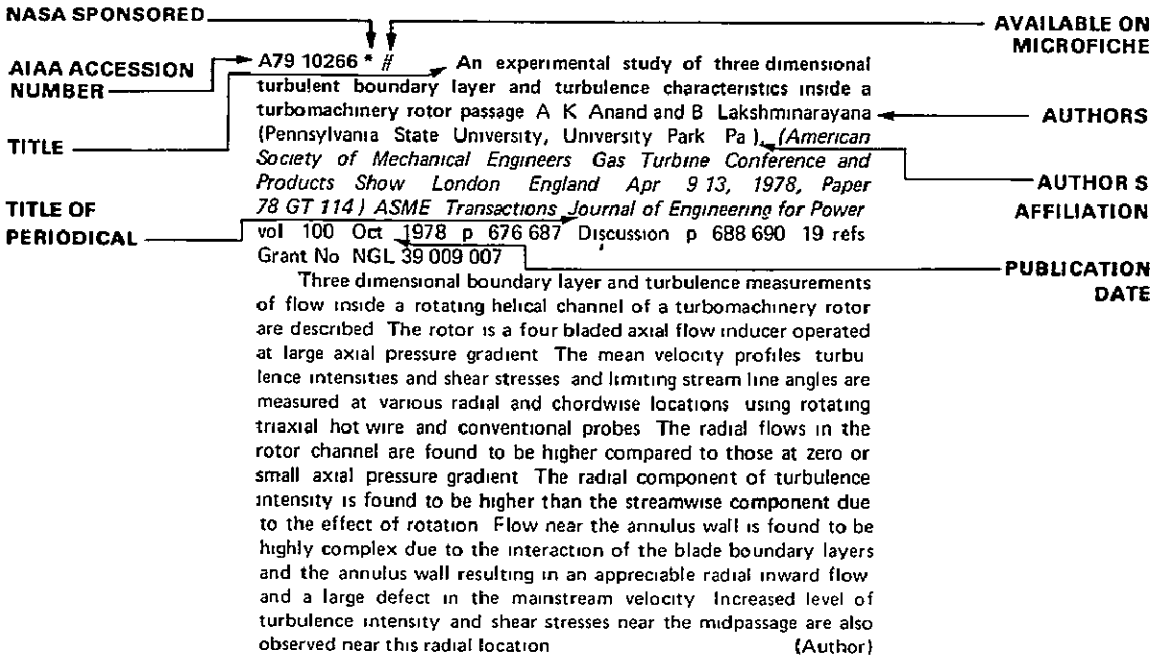

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl 111)

JULY 1979

IAA ENTRIES

A79 28422 A model for calculating the radiation field of microstrip antennas P Hammer, D Van Bouchaute, D Verschrae ven and A Van De Capelle (Leuven, Katholieke Universiteit Heverlee, Belgium) *IEEE Transactions on Antennas and Propagation* vol AP 27, Mar 1979, p 267 270 6 refs

Starting from the equivalence principle, an aperture model is developed for calculating the radiation field of microstrip antennas In this communication the model is applied to the rectangular microstrip resonator antenna Antenna characteristics, like patterns and radiation resistance, are computed and compared with experi mental results The model and the calculations include the higher order modes as well as the fundamental mode of the resonator antenna (Author)

A79-28429 A note on yawed slender wings E O Tuck (Adelaide University, Adelaide, Australia) *Journal of Engineering Mathematics,* vol 13, Jan 1979 p 47 62 16 refs Contract No N00014 76 C 0157 NR Project 062 230

A generalized Abel integral equation is derived for determining the wake lateral velocity given the wing shape of a slender yawed wing An analytical solution is obtained for a simpled yawed delta wing of triangular planform, and numerical solutions are worked out for straight edged wings P T H

A79-28432 Changing criteria in military aircraft design /The 67th Wilbur and Orville Wright Memorial Lecture/ D S Lewis *Aerospace* (UK) vol 6 Mar 1979, p 16 24

Changes in military aircraft design criteria are reviewed particu larly in the context of modern technological advances Cost and technology related problems are considered emphasizing the need for the development of techniques that would lead to cost reduction and design improvements Ways that would make possible such development are proposed A A

A79 28604 # Linearization in the recursive estimation of navigation parameters (Linearizatsiia pri rekurrentnom otsenivanii navigatsionnykh parametrov) S F Burdarov and I B Chelpanov (Leningradskii Politekhnicheskii Institut, Leningrad, USSR) *Priborostroenie,* vol 21, no 11, 1978, p 80 84 In Russian

The paper examines the general problem of the estimation of navigation parameters which are nonlinearly related to the output signals of the navigation instruments The nonlinear units are con nected only into the feedback circuits while the conversion circuit includes only signals which have the significance of increments rela tive to current values of estimates Different ways to select parame ters for the conversion circuit are discussed B J

A79 28607 # System for stabilizing the vertical overload of an aircraft (Sistema stabilizatsii vertikal'noi peregruzki letatel nogo apparata) A B Bushuev (Leningradskii Institut Tochnoi Mekhaniki i Optiki, Leningrad USSR) *Priborostroenie* vol 22 Jan 1979, p 44-49 In Russian

The successive synthesis method is used to obtain a closed form analytical expression of time optimal control for an aircraft, associated with stabilization of the vertical overload The advantage of the synthesized control is that transient processes in the stabilization system converge rapidly and are usually smooth, without overcontrol B J

A79 28611 # Reduction of cabin noise during cruise condi tions by stringer and frame damping G SenGupta (Boeing Commer cial Airplane Co , Seattle Wash) *(American Institute of Aeronautics and Astronautics, Structural Dynamics Conference 19th Bethesda, Md , Apr 3 5 1978 Paper 78 504) AIAA Journal* vol 17, Mar 1979, p 229 236 15 refs Research supported by the Boeing Inde pendent Research and Development Program

Control of low frequency cabin noise is a difficult problem in all commercial aircraft The subject is analyzed in terms of the response of a pressurized fuselage structure subjected to broadband random pressure fluctuations It is shown that in so called 'stiffness con trolled' region the structural response and noise transmission may be governed by the resonances of the stiffeners, with the skin acting like an attached mass As a result cabin noise at low frequencies may be reduced by application of constrained viscoelastic damping treat ments on the stringers and frames of the fuselage (Author)

A79-28612 # Transonic flows past nonaxisymmetric slender shapes - Classical equivalence rule analysis S S Stahara (Nielsen Engineering and Research, Inc Mountain View Calif) and J R Spreiter (Stanford University Stanford Calif) *AIAA Journal* vol 17, Mar 1979, p 245 252 18 refs Grant No DAAG29 77 C 0038

An assessment of the classical transonic equivalence rule is provided Extensive comparisons of theoretical results are made with data obtained in conventional transonic tunnels for various slender bodies as well as a thin triangular wing of unit order aspect ratio Results are reported for surface and flowfield pressure distributions at Mach numbers throughout and beyond the transonic range for both nonlifting and lifting conditions Particular attention has been paid to wind tunnel interference effects through use of an interesting alternative to the classical homogeneous wall condition whereby experimentally measured flowfield pressures are imposed as an outer boundary condition The comparisons with experiment display good agreement, including the region near shock waves and indicate that the classical equivalence rule approximation remains effective for certain three-dimensional aerodynamic configurations over a broad range of geometries and flow conditions (Author)

A79 28622 # Singularity at the trailing edge of a swept wing G J Clapworthy (North London, Polytechnic, Londor En gland) *AIAA Journal,* vol 17 Mar 1979, p 313 315 5 refs Research supported by the Science Research Council

A symmetrical wing with a Karman Trefftz profile, swept at a given angle, at zero incidence to the freestream is considered It is shown that the use of a Cartesian coordinate system that can be transformed to an appropriate nonorthogonal reference system gives rise to a singular term in the equation of motion at a sharp swept trailing edge An alternative to the present approach using a local solution appears to be the calculation of the potential at the trailing edge by extrapolation along the wing surface How sensitive the calculated flow is to difference in the numerical treatment at the trailing edge is open to conjecture S D

A79 28627 # Designing a ring for protecting the gas turbine engine casing from fragments of the rotor (Raschet kol'tsevoi zashchity pri razrushenii rotora GTD) V B Zhukov *Problemy Prochnosti* Jan 1979 p 23 28 In Russian

The present analysis deals with the calculation of the protective lining of a gas-turbine engine casing in the area requiring protection in the case of rotor failure Analytical relations are derived for calculating the required strength of the protective lining against impact of rotor and blade fragments V P

A79 28638 # A system which uses a laser beam to control the regime of vibration tests with turbine and compressor blades (Sistema kontrolia rezhima vibroispytanii lopatok turbin i kompressorov s ispol zovaniem lucha lazera) D S Elenevskii R S Bekbulatov, A P Badanin, Iu N Shaposhnikov, and I G Sipukhin *Problemy Prochnosti* Jan 1979 p 77 79 In Russian

An optical system for controlling the load in vibration tests with turbine and compressor blades is described and its block diagram is discussed Some factors leading to control errors are examined and means of eliminating them are proposed V P

A79 28718 # A generalized 'capacity pressure rotational velocity equation for axial turbines (Equazione generalizzata 'portate pressioni velocita di rotazione' per turbine assiali) A E Catania (Torino Politecnico Turin Italy) *Torino Accademia delle Scienze, Classe di Scienze Fisiche Matematiche e Naturali, Atti*, vol 111, May Aug 1977, p 331 354 9 refs In Italian Research supported by Fiat S p A

A capacity pressure equation which includes the corrected angular velocity parameter is developed for axial turbines The generalized equation is intended to provide accurate pressure characterization of turbines having a low number of stages The capacity pressure equation is adopted to study the operating limits of a two stage turbine suitable for aeronautical applications J M B

A79-28721 # The determination of parameters of a chemically active magnetogasdynamic medium in the proximity of a wave II A G Bagdoev and A A Gurgenian (Erevanskii Politekhnicheskii Institut, Yerevan Armenian SSR) *Torino Accademia delle Scienze Classe di Scienze Fisiche, Matematiche e Naturali, Atti* vol 111 Sept Dec 1977, p 493 502

The flow of a chemically active nonhomogeneous magnetogas dynamic medium near a slender wing having a supersonic leading edge is considered The linear and nonlinear solutions near the tangency of the leading shock and the Mach cone are obtained The equations of slowly varying amplitude and phase of waves in nonlinear dispersive media are developed as well (Author)

A79-28835 # Attached shock regime at the edges of a conical wing (O rezhime prisoedinennogo skachkaxuplotnenia na kromkakh V-obraznogo kryla) A V Grishin and E G Shifrin *Prikladnaia Matematika i Mekhanika* vol 43 Jan Feb 1979 p 38 44 9 refs In Russian

The transonic approximation for the supersonic flow past a conical wing is considered In a linear formulation the behavior of the solution in regimes close to flow with planar shock wave stretched along the edges is studied It is shown that if the planar shock at the edges in a plane perpendicular to the edge is weak, then the character of the flow will not be changed as the Mach number varies If the shock in the main flow is strong however a change in flow parameters will result in a change in flow regime P T H

A79-28846 # The method of discrete vortices (O metode diskretnykh vikhrei) I K Lifanov *Prikladnaia Matematika i Mekhanika*, vol 43 Jan Feb 1979 p 184 188 7 refs In Russian

The method of discrete oblique horseshoe vortices is applied to the linear problem of steady flow past a finite span wing of complex planform and past a schematized aircraft with straight edges An integral equation for the strength of the vortex layer on the wing is obtained It is shown that the quadrature sums obtained in this method converge to the integral appearing in the integral equation A numerical solution method is given It is shown that the required class of solutions of the integral equation for the vortex layer strength is distinguished only by the mutual positions of the sets of discrete vortices and grid points P T H

A79-28885 Fatigue crack propagation rate at low delta-K of two aluminum sheet alloys 2024-T3 and 7075 T6 T L Mackay (Douglas Aircraft Co , Long Beach, Calif) *Engineering Fracture Mechanics* vol 11 no 4, 1979 p 753 759, 761 12 refs

For transport aircraft with long lifetimes crack growth data to implement the durability life requirements in the low delta K (stress intensity factor range) are needed This is the region comprising most of the lifetime for the cracks of interest, and it is also the region where there is little data available Crack growth data in the form of da/dN vs delta K vs R at constant amplitude for two primary aircraft aluminum sheet alloys 2024 T3 and 7075 T6 (clad) were measured in laboratory air and 140 F in the low da/dN region 10 to the minus 8th to 10 to the minus 5th in /cycle Crack growth rates were correlated with stress state and with fractographic features (Author)

A79-28890 * Stress-intensity factors for a wide range of semi elliptical surface cracks in finite thickness plates I S Raju and J C Newman Jr (NASA Langley Research Center, Hampton Va) *Engineering Fracture Mechanics*, vol 11 no 4 1979, p 817 829 14 refs

Surface cracks are among the more common flaws in aircraft and pressure vessel components Several calculations of stress intensity factors for semi elliptical surface cracks subjected to tension have appeared in the literature However some of these solutions are in disagreement by 50 100% In this paper stress intensity factors for shallow and deep semi elliptical surface cracks in plates subjected to tension are presented To verify the accuracy of the three dimensional finite element models employed convergence was studied by varying the number of degrees of freedom in the models from 1500 to 6900 The 6900 degrees of freedom used here were more than twice the number used in previously reported solutions Also, the stress intensity variations in the boundary layer region at the intersection of the crack with the free surface were investigated (Author)

A79-28891 Fatigue reliability under multiple-amplitude loads R Talreja (Danmarks Tekniske Hojskole, Lyngby, Denmark) *Engineering Fracture Mechanics*, vol 11, no 4 1979, p 839 849 12 refs Research supported by the Danmarks Teknisk Videnskabelige Forskningsrad

A method to determine the fatigue reliability of structures subjected to multiple amplitude loads is presented Unlike the more common cumulative damage methods which are usually based on fatigue life data, the proposed method is based on tensile strength data Assuming the Weibull distribution for the initial tensile strength and the fatigue life, the probability distributions for the residual tensile strength in both the crack initiation and the crack propagation stages of fatigue are determined The method is illustrated for two amplitude loads by means of experimental results obtained by testing specimens of a structural steel and is shown to be more accurate than the Palmgren Miner cumulative damage method (Author)

A79 28954 # Jet mixing noise Comparison of measurement and theory B J Tester (Lockheed Georgia Co , Marietta, Ga) and' V M Szewczyk (Rolls Royce Ltd Derby England) *American Institute of Aeronautics and Astronautics Aeroacoustics Conference 5th Seattle Wash , Mar 12 14, 1979 Paper 79 0570* 21 p 17 refs Contract No F33615 76 C 2021

Previous work on the development of a physically based prediction model for jet mixing noise is extended to include angles inside the cone of silence Acoustic mean flow interaction effects are modelled by high frequency Lilley equation solutions which contain the local shear layer thickness as a Strouhal number dependent parameter Values empirically determined from mixing noise data are found to agree well with those deduced from source location data except at low Strouhal numbers A prediction scheme based on these results is compared with published data over a wide range of angles, velocities and temperatures with very encouraging results (Author)

A79 28955 # The generation and propagation of sound in turbulent jets C H Berman (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference 5th, Seattle, Wash , Mar 12 14 1979 Paper 79 0573* 16 p 38 refs

A new noise prediction program for axisymmetric ideally expanded jets with arbitrary nozzle flow profiles has been developed The program computes the mean and turbulent flow properties throughout the jet and calculates noise with the aid of Lilley s theory and an empirical turbulence spectrum model The critical point problem in which a sound wave s phase velocity equals the local flow velocity, is treated thoroughly An entropy fluctuation term contributes to noise generation in heated jets Predictions are compared to data for a range of hot and cold subsonic and supersonic jets (Author)

A79 28959 # The influence of propeller design parameters on far field harmonic noise in forward flight D B Hanson (United Technologies Corp Hamilton Standard Div , Windsor Locks Conn) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th Seattle Wash , Mar 12-14, 1979, Paper 79 0609* 18 p 11 refs

The acoustic analogy is used to derive far field noise radiation equations for high speed propellers in flight via a helicoidal surface representation Quadrupole terms are included and discussed but only the linear sources are studied in detail The frequency domain results clarify the role of acoustic noncompactness (noise cancella tion due to finite chord and span effects) Nondimensional parame ters arising from the analysis give design guidance by showing the potential for noise reduction due to changes in airfoil section and blade sweep twist and taper as functions of operating conditions Conventional propellers are shown to be relatively insensitive to variations in blade design However, advanced turbo propellers (Prop Fans) currently under development are decidedly noncompact because of their high solidity and speed Examples of chordwise and spanwise cancellation are given illustrating substantial benefits of sweep (Author)

A79 28960 # Aeroacoustic design of the Prop Fan F B Metzger and C Rohrbach (United Technologies Corp Hamilton Standard Div Windsor Locks Conn) *American Institute of Aero nautics and Astronautics, Aeroacoustics Conference, 5th, Seattle Wash , Mar 12 14 1979, Paper 79 0610* 15 p 8 refs

Acoustic and aerodynamic tests for three models of the Prop Fan an advanced fuel efficient propulsion system for high speed subsonic aircraft have recently been completed The aerodynamic and acoustic tradeoffs, which resulted in the test configurations, are described The performance and noise characteristics of models with unswept, slightly swept and highly swept blade configurations are discussed The design concept used for the most recent highly swept blade design is discussed in detail This is the concept of reducing noise by optimizing the phase cancellation of noise originating at various spanwise locations on the Prop Fan blades Also the benefits of sweep in reducing the level of the nonlinear (quadrupole) sources are described with respect to the test results The differences between predicted and measured levels are summarized and plans for improvements in noise prediction methodology are discussed (Author)

A79 28961 * # Flight effects on subsonic jet noise V Sarohia (California Institute of Technology, Jet Propulsion Laboratory, Pasadena Calif) *American Institute of Aeronautics and Astronau tics Aeroacoustics Conference, 5th, Seattle Wash Mar 12 14, 1979, Paper 79 0616* 10 p 16 refs Contract No NAS7 100

Experimental results obtained by a combination of fluid mechanics and radiated noise measurements associated with subsonic jets over a range of simulated flight speeds between 25 m/s and 110 m/s indicate that noise reduction in flight is predominantly a result of the reduced noise producing volume These results do not support the generally accepted notion that noise reduction from jets in motion results primarily from the reduced strength of the noise producing eddies These eddies in flight, have previously been assumed to scale with the relative velocity V(J) Vo where V(J) is the mean nozzle exit velocity and Vo is the flight velocity (Author)

A79-28962 * # Analysis of flight effects on noise radiation from dual flow coaxial jets R Dash (NASA Ames Research Center, Moffett Field Calif) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference 5th Seattle Wash Mar 12 14, 1979 Paper 79 0619* 16 p 23 refs

A theoretical study has been made of the effects of flight on noise from dual flow coaxial jets The theory is based on an instability free vortex sheet flow model It is shown that the flight effects are more favorable (and hence produce less forward arc amplification) for coaxial jets than for single stream jets Further the theory predicts that like the single stream jet case, flight effects induce noise amplification in the forward quadrant and attenuation in the aft quadrant and have virtually no effect at theta = 90 deg to the jet axis, where theta is the angle between the directions of convection and emission at the retarded time Amplification in the forward quadrant diminishes as the inner flow velocity increases and becomes optimum when the outer to inner velocity ratio is about 0 5 The theory also shows that the higher the outer to inner area ratio the lower the forward arc amplification due to flight (Author)

A79 28963 * # Experimental study of coaxial nozzle exhaust noise J H Goodykoontz and J R Stone (NASA Lewis Research Center, Jet Acoustics Branch Cleveland Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th Seattle Wash , Mar 12-14, 1979 Paper 79 0631* 29 p 11 refs

Experimental results are presented for static acoustic model tests of various geometrical configurations of coaxial nozzles operat ing over a range of flow conditions The geometrical configurations consisted of nozzles with coplanar and non coplanar exit planes and various exhaust area ratios Primary and secondary nozzle flows were varied independently over a range of nozzle pressure ratios from 1 4 to 3 0 and gas temperatures from 280 to 1100 K Acoustic data are presented for the conventional mode of coaxial nozzle operation as well as for the inverted velocity profile mode Comparisons are presented to show the effect of configuration and flow changes on the acoustic characteristics of the nozzles (Author)

A79-28964 * # A jet exhaust noise prediction procedure for inverted velocity profile coannular nozzles R S Larson (United Technologies Corp Pratt and Whitney Aircraft Group East Hart ford Conn) *American Institute of Aeronautics and Astronautics Aeroacoustics Conference, 5th Seattle Wash , Mar 12-14, 1979, Paper 79 0633* 21 p 26 refs Contract No NAS3 20061

Acoustic model tests have demonstrated that significant noise suppression can be obtained from inverted velocity profile coannular nozzles An acoustic prediction procedure was developed for inverted velocity profile coannular nozzles that can be used to predict SPL spectra as a function of nozzle geometry and flow conditions In the development of this prediction procedure, the noise spectrum at a

given angle was decomposed into four noise components a low frequency mixing noise component, a high frequency mixing noise component an outer stream shock noise component, and an inner stream shock noise component The physics of the inverted velocity flow field development was used to formulate noise generation models Scaling laws for each noise component were defined based on these models Comparisons of predictions from this procedure with experimental data were conducted to verify the prediction procedure (Author)

A79-28965 # Asymmetric stator interaction noise T G Sofrin and D C Mathews (United Technologies Corp Pratt and Whitney Aircraft Group, East Hartford Conn) *American Institute of Aeronautics and Astronautics Aeroacoustics Conference 5th Seattle Wash , Mar 12 14, 1979 Paper 79 0638* 10 p

Noise reduction benefits of nominally cut off rotor stator designs are limited in practice by deviations from symmetry in fan construction and by operating airflow irregularities One type of asymmetry is a set of small random variations from precisely equal spacing in the circumferential stator vane positions Acoustic tests on a model fan suggested that this asymmetry due to manufacturing imperfection, was the source of radiated sound at blade passage frequency for a rotor/stator combination designed to be cut-off An analysis of the fan noise produced by extraneous propagating modes generated by rotor wake interaction with stator vanes that have random vane angle deviations is given here Comparison of predicted tone levels with model fan data indicates good quantitative agreement Inferences are made about the effects of stator asymmetry in full scale engine fans (Author)

A79 28966 * # Lateral noise attenuation results from flyovers of three transport aircraft E M Mashita and A B Bauer (Douglas Aircraft Co , Long Beach, Calif) *American Institute of Aeronautics and Astronautics Aeroacoustics Conference 5th Seattle Wash Mar 12-14, 1979, Paper 79 0651* 8 p 6 refs Contract No NAS1 15267

Lateral noise attenuation data have been compiled in a one-third octave band analysis from an available set of flyover tests using DC 8, DC 9 and DC 10 aircraft For an intermediate frequency range of 400 through 2000 Hertz the lateral noise has been approximately separated into its two components the excess ground attenuation and the aircraft shielding attenuation Both attenuation factors varied from a maximum at small elevation angles to zero at an elevation angle of approximately 40 degrees The lateral attenuation in this range generally did not vary with frequency For frequencies of 80 Hertz and lower, negative lateral attenuation values were obtained For high frequencies, the data were not complete enough to generate definitive lateral attenuation curves (Author)

A79 28967 * # Acoustic duct liner optimization using finite elements A L Abrahamson (Wyle Laboratories Hampton, Va) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th Seattle Wash Mar 12-14, 1979 Paper 79 0662* 9 p 7 refs NASA supported research

Determination of a mathematical model which may be used for obtaining optimum acoustic liners in aeroengine ducts was the goal of this study Starting with a baseline finite element model which consumed too much computer time to permit optimum liner evaluation for realistic ducts and source frequencies, a survey was conducted of candidate methods for reducing computational effort A highly effective boundary exclusive decomposition method was developed which enables L U decomposition of a major partition of the global matrix to be performed once only Timing experiments using the technique in duct liner optimization show a reduction of between one and two orders of magnitude in the central processor unit (CPU) time of the baseline model (Author)

A79 28969 * # Airframe noise component interaction studies M R Fink and R H Schlinker (United Technologies Research Center, East Hartford Conn) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th Seattle, Wash Mar 12 14, 1979, Paper 79 0668* 12 p 18 refs Contract No NAS1 15083

Acoustic wind tunnel tests were conducted to examine the noise-generating processes of an airframe during approach flight The airframe model was a two-dimensional wing section to which highlift leading and trailing edge devices and landing gear could be added Far field conventional microphones were utilized to determine component spectrum levels An acoustic mirror directional microphone was utilized to examine noise source distributions on airframe components extended separately and in combination Measured quantities are compared with predictions inferred from aircraft flyover data Aeroacoustic mechanisms for each airframe component are identified Component interaction effects on total radiated noise generally were small (within about 2 dB) However some interactions significantly redistributed the local noise source strengths by changing local flow velocities and turbulence levels Possibilities for noise reduction exist if trailing edge flaps could be modified to decrease their noise radiation caused by incident turbulent flow (Author)

A79 28970 * # Investigation of wing shielding effects on CTOL engine noise H E Bloomer (NASA, Lewis Research Center, Cleveland Ohio) *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference 5th, Seattle Wash , Mar 12-14 1979 Paper 79 0669* 33 p 9 refs

A full scale engine wing shielding investigation was conducted at the Lewis Research Center using a 97 900 N (22,000 lb) thrust turbofan engine and a simulated wing section sized around a conventional take off type four engine narrow body airplane Sound data were obtained for the wing placed at seven positions in a plane parallel to the engine axis, and were compared to data obtained without the wing at both take off and approach power In addition the engine was operated with and without extensive acoustic treatment including a sonic inlet in order to evaluate wing shielding effectiveness with a highly suppressed engine The wing shielding effectiveness was also calibrated using a 3 8 cm diam air nozzle as a sound source Results indicated that even though about 10 dB broad band shielding was achieved, the equivalent flyover noise reduction was less than 3 0 EPNdB for most configurations (Author)

A79 28971 * # Twin jet noise shielding for a supersonic cruise vehicle J S Clauss, Jr B R Wright and G E Bowie (Lockheed California Co Burbank Calif) *American Institute of Aeronautics and Astronautics Aeroacoustics Conference, 5th Seattle, Wash Mar 12 14 1979 Paper 79 0670* 11 p 9 refs Contract No NAS1 14625

An engine arrangement for a supersonic cruise vehicle (SCV) has been developed that shows promise for jet noise reduction without the performance penalties associated with mechanical suppressors and engine oversizing This arrangement wherein two engines are placed on top of the wing directly above two similarly mounted engines below the wing, can produce 3 to 5 dB less noise below the aircraft flight path than when four engines are installed under the wing This noise reduction is due to acoustic shielding of the upper jets by the lower jets Test data are reviewed to verify this acoustical shielding phenomenon, and detailed takeoff trajectories are calculated to show the effects of sideline and flyover noise levels on constraining maximum range SCV configurations Engine placement variation and differential throttling, wherein thrust is unloaded from the lower engine and added to the upper engine are to be explored as means for maximizing the shielding effect (Author)

A79-28976 The quiet revolution in airframe construction C Bulloch *Interavia*, vol 34 Mar 1979 p 207 211

Recent developments in airframe manufacturing techniques are reviewed together with a discussion of composite materials Current NASA R&D activities are considered as are the adhesive bonding the diffusion bonding, and the superplastic forming methods Improved welding and fastening techniques are noted, emphasizing the development of an automated assembly fixture drilling system

Pitch based and PAN-derived fibers as well as the Kevlar 49 aramid fiber and the ceramic fibers are taken into account with attention to their environmental stability, producibility and damage tolerance
A A

A79 28977 Future trends in aircraft structural materials W A Stauffer and J H Wooley (Lockheed California Co Burbank Calif) *Interavia,* vol 34, Mar 1979 p 212 214

Structural materials expected to meet technological demands in future aircraft are discussed Improvements in aluminum alloys are considered noting the use of the powder process and the concept of adding lithium, both leading to a 10 to 15% weight reduction in current aluminum aircraft components The new 'beta' and near beta' titanium alloys are taken into account, as are high and low strength steel alloys, including the AF 1410 steel projected to be used for fittings pins and fasteners Present and potential uses of fiber matrix materials, particularly of the Kevlar 49 aramid fiber are mentioned emphasizing their stiffness to weight and strength to weight qualities
A A

A79 28979 US commuter operations climate changing L Davis *Interavia,* vol 34 Mar 1979 p 252 254

US commuter airlines are discussed in the light of recent Congressional and regulatory rulings The growth potential is considered, noting that by 1990 passenger boardings are expected to rise 101%, although various problems, such as keeping the existing gate and service positions at major hub terminals, remain still unresolved The implementation of the joint fare schedules with certificated carriers, the FAA proposal to guarantee loans of up to $100 million per carrier and route subsidies are taken into account The significance of the proposed Airport Development Program is noted, together with a description of the inadequacies of ground facilities The impact of the FAR (Federal Air Regulation) Part 135 and Part 24 rules on the financial situation of the airlines is also noted
A A

A79-28980 GPS A universal navigation aid D Boyle *Interavia* vol 34 Mar 1979 p 266 268

The Global Positioning System (GPS) also known as Navstar, is designed to provide very high accuracy position data for a wide variety of military users including en route navigation for space air land and sea vehicles The GPS is described noting that it consists of a space segment equipped with 24 satellites in three separate orbits of ground control stations monitoring the system s operation and providing corrections, and of a 'user segment receiving the satellite signals and converting them into navigational data Progress to date is noted emphasizing the development of user terminals and of the first manpack unit, weighing only 14 kg and with a power consumption of 29 W Also noted are cost and potential for civilian uses
A A

A79-29003 # Flap lag stability with dynamic inflow by the method of multiblade coordinates G H Gaonkar (Indian Institute of Science, Bangalore, India) and D A Peters (Washington University, St Louis, Mo) In Structures, Structural Dynamics, and Materials Conference, 20th St Louis, Mo , April 4 6 1979, Technical Papers on Structures and Materials
New York, American Institute of Aeronautics and Astronautics, Inc 1979 p 1 12 9 refs Research supported by the Southern Illinois University NSF Grant No ENG 76 84439 (AIAA 79 0729)

Rotor flap lag stability in forward flight is studied with and without dynamic inflow feedback via a multiblade coordinate transformation (MCT) The algebra of MCT is found to be so involved that it requires checking the final equations by independent means Accordingly, an assessment of three derivation methods is given Numerical results are presented for three and four bladed rotors up to an advance ratio of 0 5 While the constant-coefficient approximation under trimmed conditions is satisfactory for low frequency modes it is not satisfactory for high frequency modes or for untrimmed conditions
(Author)

A79-29006 * # Formulation of the aeroelastic stability and response problem of coupled rotor/support systems W Warmbrodt (NASA Ames Research Center Moffett Field Calif) and P Friedmann (California University, Los Angeles Calif) In Structures, Structural Dynamics, and Materials Conference 20th, St Louis, Mo , April 4 6, 1979, Technical Papers on Structures and Materials New York American Institute of Aeronautics and Astronautics Inc 1979 p 39 52 23 refs Army supported research Grants No NsG 3082 No NGR 05 007 414 (AIAA 79 0732)

The consistent formulation of the governing nonlinear equations of motion for a coupled rotor/support system is presented Rotor/support coupling is clearly documented by enforcing dynamic equilibrium between the rotor and the moving flexible support The nonlinear periodic coefficient equations of motion are applicable to both coupled rotor/fuselage aeroelastic problems of helicopters in hover or forward flight and coupled rotor/tower dynamics of a large horizontal axis wind turbine (HAWT) Finally, the equations of motion are used to study the influence of flexible supports and nonlinear terms on rotor aeroelastic stability and response of a large two bladed HAWT
(Author)

A79-29007 * # Evaluation of MOSTAS computer code for predicting dynamic loads in two bladed wind turbines K R V Kaza (NASA, Lewis Research Center Cleveland Toledo University, Toledo, Ohio) D C Janetzke, and T L Sullivan (NASA Lewis Research Center Wind Energy Projects Office, Cleveland Ohio) In Structures, Structural Dynamics, and Materials Conference 20th St Louis, Mo , April 4 6 1979 Technical Papers on Structures and Materials New York American Institute of Aeronautics and Astronautics Inc , 1979, p 53 63 13 refs (AIAA 79 0733)

Calculated dynamic blade loads are compared with measured loads over a range of yaw stiffnesses of the DOE/NASA Mod 0 wind turbine to evaluate the performance of two versions of the MOSTAS computer code The first version uses a time averaged coefficient approximation in conjunction with a multiblade coordinate transformation for two bladed rotors to solve the equations of motion by standard eigenanalysis The results obtained with this approximate analysis do not agree with dynamic blade load amplifications at or close to resonance conditions The results of the second version, which accounts for periodic coefficients while solving the equations by a time history integration compare well with the measured data
(Author)

A79-29011 # Airplane dynamic wheel loads during ground maneuvering M A Gamon (Lockheed California Co , Burbank Calif) In Structures Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4 6, 1979 Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics Inc 1979 p 95 101 (AIAA 79 0739)

During the initial design stages of the L 1011 program Lockheed developed a digital computer program capable of predicting a wide variety of dynamic ground handling loads The program s capabilities include such analyses as crosswind yawed landings and rollouts, dynamic steering maneuvers including braked turns, vehicle response to runway roughness and emergency landing conditions with one or more gears deranged This computer program has been used extensively for the prediction of L 1011 ground maneuver loads fatigue spectra crosswind landing analyses, and emergency landing conditions This paper presents a description of the analytical features of the program, the results of a correlation study using L 1011 ground maneuvering test data, and the results of a parameter variation study
(Author)

A79 29013 # Statistical analysis of aircraft maneuvering data R R Lauridia (Vought Corp Dallas Tex) In Structures Structural Dynamics, and Materials Conference, 20th, St Louis Mo ,

A79 29028 # Large plastic deformation analysis of impulsively loaded curved frames C T Chon (GM Research Laboratories Warren Mich) In Structures Structural Dynamics, and Materials Conference, 20th, St Louis Mo April 4 6, 1979 Technical Papers on Structures and Materials New York American Institute of Aeronautics and Astronautics, Inc , 1979 p 258 266 14 refs (AIAA 79 0784)

An effective numerical method based on the mode approximation technique is proposed for the analysis of frame structures undergoing large deflections due to impact loading The method is applied to the assessment of a curved thin walled frame structure subjected to impulsive loading The material behavior is taken as nonlinear viscous in a way which enables rigid viscoplastic behavior and, in the limiting case, rigid perfectly plastic behavior to be represented realistically The cross section of the frame is idealized into a simpler mechanical model The constitutive equations derived account for full interaction between the three stress resultants (two bending moments and one axial force the twisting moment being neglected) The cross sectional dimensions are chosen such that the two bending moments and the axial force are the same as those of the original size cross section the rectangular cross section being considered as a limiting case of the thin walled box cross section S D

A79 29032 # Dynamic response analysis of an F-15 Fast Pack optical system installation W E Triplett (McDonnell Aircraft Co , St Louis Mo) In Structures Structural Dynamics and Materials Conference 20th St Louis Mo April 4 6 1979 Technical Papers on Structures and Materials New York American Institute of Aeronautics and Astronautics Inc 1979 p 290 295 USAF-sponsored research (AIAA 79 0788)

The dynamic response is presented for a distributed optical system mounted within a modified F 15 Fast Pack pallet The response is produced as a result of (1) aircraft vibration introduced through five pallet/aircraft attach points, and (2) fluctuating aero dynamic pressures acting on the pallet skin and the exposed optical sensor The aircraft vibration was obtained from instrumented flight test maneuvers and the fluctuating pressures were scaled from wind tunnel measurements on a 7 5% model The MCAIR computer graphics system formed the basis for the three dimensional finite element structural and vibration analyses and the entire response study was conducted with automated hands off plotting and data transfer Uncompensated vibration levels (rms) up to 0 3 inch in deflection and 2 0 milliradians in rotation are predicted during moderate buffet maneuvers Active line of sight stabilization may be required for a large class of sensors contemplated for F 15 Fast Pack applications (Author)

A79 29033 # Adaptive control of wing store flutter - A feasibility study C A Harvey (Honeywell Systems and Research Center Minneapolis Minn), G Stein (Honeywell Systems and Research Center Minneapolis Minn , MIT Cambridge Mass) and L R Felt (USAF Flight Dynamics Laboratory, Wright Patterson AFB Ohio) In Structures, Structural Dynamics and Materials Conference 20th St Louis Mo April 4 6 1979 Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics Inc 1979, p 296 304 11 refs Research supported by the Honeywell Independent Research and Development Funds, Contract No F33615 77 C 3096 (AIAA 79 0789)

The status and preliminary results are presented of a feasibility study intended to define and explore several approaches to the adaptive control of wing/store flutter problem Attention is given to three different wing/store flutter modes with widely varying flutter characteristics which are modeled on a realistic fighter/attack aircraft design Prior knowledge of the three modes is assumed The models used are described along with the solution that adaptive control would provide The results confirm the suitability of adaptive control in a realistic environment for active flutter suppression S D

A79-29034 # Design development, and testing of an active flutter margin augmentation system for a commercial transport airplane R F O'Connell and A F Messina (Lockheed California Co , Burbank, Calif) In Structures Structural Dynamics and Materials Conference 20th St Louis Mo April 4 6 1979 Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics Inc , 1979 p 305 314 6 refs (AIAA 79 0790)

A research program was conducted to determine the feasibility of the use of active control systems to achieve increased flutter margins on a commercial transport airplane Three candidate systems were designed, developed and installed on an L 1011, and the effectiveness of each system in increasing the damping of a lightly damped wing engine mode was evaluated in a flight test program This paper describes each phase of this effort in detail, and includes discussions of the available data base relation of the flutter margin augmentation (FMA) effort to the general active controls research, availability of control systems and components, candidate FMA systems control law development, analysis and flight test results The evaluation of the candidate systems and associated trade offs which enter into the selection process are discussed In addition, certain aspects of certification of such systems are discussed and proposals are presented for the certification of near term and far term systems which would result in levels of safety for flutter comparable to those of other disciplines such as gust loads (Author)

A79-29035 * # Decoupler pylon A simple effective wing/store flutter suppressor W H Reed J T Foughner, Jr (NASA, Langley Research Center Hampton Va) and H L Runyan Jr (George Washington University, Hampton Va) In Structures Structural Dynamics and Materials Conference 20th St Louis Mo April 4-6, 1979, Technical Papers on Structures and Materials New York American Institute of Aeronautics and Astronautics, Inc , 1979 p 315 321 9 refs (AIAA 79 0791)

As an alternative to alleviating wing/store flutter by conventional passive methods or by more advanced active control methods a quasi passive concept, referred to as the decoupler pylon is investigated which combines desirable features of both methods Passive soft spring/damper elements are used to decouple wing modes from store pitch modes and a low power control system maintains store alignment under changing mean loads It is shown by analysis and wind tunnel tests that the decoupler pylon provides substantial increase in flutter speed and makes flutter virtually insensitive to inertia and center of gravity location of the store (Author)

A79-29036 # Coupled bending torsion flutter in cascades O Bendiksen and P Friedmann (California, University, Los Angeles Calif) In Structures Structural Dynamics and Materials Conference, 20th, St Louis, Mo April 4 6, 1979, Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics Inc 1979 p 322 334 27 refs (AIAA 79 0793)

A method is presented for determining the aeroelastic stability boundaries of a cascade with aerodynamic, inertial, and structural coupling between the bending and torsional degrees of freedom A computer program has been written to systematically investigate the effect of this coupling on cascade stability over a wide range of design parameters Results presented illustrate that the bending-torsion interaction has a pronounced effect on the cascade flutter boundary, despite no appreciable tendency toward frequency coalescence as flutter is approached The analysis also indicates that bending flutter is possible even in the absence of finite mean lift (Author)

A79-29037 # Effect of chordwise forces and deformations and deformations due to steady lift on wing flutter W N Boyd (Boeing Commercial Airplane Co , Renton, Wash) In Structures Structural Dynamics, and Materials Conference, 20th, St Louis, Mo ,

April 4 6, 1979, Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics Inc 1979, p 335 344 8 refs Grant No AF AFOSR-74 2712 (AIAA 79 0794)

The influence of chordwise forces, chordwise deformation and steady state deformation due to lift on static and dynamic aeroelastic stability is investigated with the uniform cantilever wing as a model Cases are found for which divergence and flutter speeds are lowered upon inclusion of these forces and deformations into the analysis Results are believed to have practical applications for high performance sailplanes and certain RPV's (Author)

A79 29038 # Flutter speed degradation of damaged, optimized flight vehicles F G Hemmig, V B Venkayya and F E Eastep (USAF, Flight Dynamics Laboratory Wright Patterson AFB, Ohio) In Structures, Structural Dynamics and Materials Conference, 20th, St Louis, Mo April 4 6 1979 Technical Papers on Structures and Materials New York American Institute of Aeronautics and Astronautics Inc , 1979 p 345 351 15 refs (AIAA 79 0795)

A study of the effects of mass and stiffness changes on the flutter degradation of optimized wings is presented in this paper The wings were optimized for weight with constraints on strength displacement and flutter speed The mass and stiffness changes are representative of battle damage The structural box is idealized by finite elements consisting of membranes shear panels and bar elements The aerodynamic force matrix is generated by incompressible strip theory Five damage models involving two wing boxes are included in this study (Author)

A79 29040 * # Investigation of flexible nozzle wall flutter incidents in the NASA Ames Research Center 11 by 11 foot transonic wind tunnel L L Erickson D L Kassner L R Guist and M K Chargin (NASA, Ames Research Center, Moffett Field Calif) In Structures, Structural Dynamics and Materials Conference, 20th, St Louis, Mo April 4 6 1979 Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics, Inc 1979 p 360 382 13 refs (AIAA 79 0797)

Twice during the spring of 1978, the two steel plate flex walls' that form the variable-geometry nozzle of the 11- by 11 foot tunnel at Ames Research Center experienced a severe dynamic instability Both walls fluttered in the fundamental beam bending mode and experienced stresses approaching the yield strength of the material Both flutter incidents occurred at Mach numbers of about 1 15 The tunnel, operational for 24 years had no history of such an instability The cause of these flutter incidents the steps taken to prevent a recurrence, and the requalification of the facility are described (Author)

A79-29041 # An overview of technical problems in helicopter rotor loads prediction methods D P Schrage (U S Army Aviation Research and Development Command St Louis, Mo) In Structures Structural Dynamics and Materials Conference, 20th St Louis, Mo April 4 6 1979, Technical Papers on Structures and Materials New York American Institute of Aeronautics and Astronautics, Inc 1979, p 383 389 6 refs (AIAA 79 0816)

The paper discusses technical problems in the analytical prediction of the dynamic loads existing in helicopter rotor blades hub, and blade pitch control mechanisms Accurate analytical prediction of the loads generated by a rotor requires a sophisticated mathematical description of the dynamics characteristics of the rotor system, together with adequate definition of aerodynamic forcing functions The various aspects of the analytical procedure will be described and the level of detail required with respect to aerodynamics and structural dynamics will be discussed Examples of dynamic component redesign during development as a result of inaccurate rotor loads predictions will be presented (Author)

A79-29042 * # Research needs in aerospace structural dynamics A K Amos (NASA, Washington, D C) and R C Goetz (NASA, Langley Research Center Dynamic Loads Branch Hampton Va) In Structures Structural Dynamics and Materials Conference 20th, St Louis, Mo , April 4 6 1979 Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics Inc , 1979 p 390 394 (AIAA 79 0826)

The perspective of a NASA Ad Hoc Study Committee on future research needs in structural dynamics within the aerospace industry is presented It identifies the common aspects of the design process across the industry and establishes the role of structural dynamics in it through a discussion of various design considerations having their basis in structural dynamics The specific structural dynamics issues involved in these considerations are identified and assessed as to their current technological status and trends Projections of future requirements based on this assessment are made and areas of research to meet them are identified (Author)

A79-29045 # Structural parameter identification from measured vibration data R R Ensminger and M J Turner (Boeing Co , Seattle, Wash) In Structures Structural Dynamics and Materials Conference, 20th, St Louis, Mo , April 4 6 1979, Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics Inc 1979, p 410-416 12 refs (AIAA 79 0829)

A method is presented utilizing complex modal information from response measurements with transient excitation for the digital simulation of a multiple shaker test Generalized equations of motion, referred to conservative modal coordinates are obtained Results may be used for evaluation of the analytical dynamic model of the structure, or directly in an aeroelastic analysis in lieu of an analytical model The method was applied using the data from the ground vibration test of the 747 CAM airplane, the results of which predict response from a single excitation input in good agreement with responses obtained directly from measurements (Author)

A79 29046 # An application of ground vibration test results to calculate aeroelastic stability and control parameters C R Stockdale (Northrop Corp Hawthorne Calif) In Structures, Structural Dynamics and Materials Conference 20th, St Louis, Mo , April 4 6 1979, Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics Inc , 1979, p 417 427 11 refs (AIAA 79 0830)

A method to integrate experimental ground vibration test results and theoretical aerodynamics to calculate symmetric aeroelastic stability and control parameters is presented This method employs experimental asymmetric unconstrained vibration modes and aircraft geometrical and inertial properties to estimate a clamped' asymmetric structural influence coefficient (SIC) matrix This matrix is reduced to a proper format to be used in the FLEXSTAB computer program system FLEXSTAB is used to estimate the desired parameters SICs and resulting parameters calculated using this method compare favorably with similar data estimated using another method (Author)

A79-29049 * # Design maneuver loads for an airplane with an active control system H D Ramsey and J G Lewolt (Lockheed California Co Burbank Calif) In Structures, Structural Dynamics and Materials Conference 20th, St Louis Mo , April 4 6 1979 Technical Papers on Structures and Materials New York American Institute of Aeronautics and Astronautics, Inc , 1979, p 456 464 Contract No NAS1 14690 (AIAA 79 0738)

This paper discusses the results of utilizing a maneuver load control (MLC) system to provide relief from the loads induced by an increase in wing span on a long range version of the Lockheed L 1011 TriStar The MLC system deflects the outboard aileron symmetrically, in response to accelerometer signals to redistribute

wing airloads during maneuvers The process of establishing the MLC system requirements which involves determining the effects on wing loads of the extended wing span and extended aileron is discussed Effects of the MLC system and the extended span on the wing loads for symmetric and asymmetric design maneuvers are reviewed Flight test results are compared with analytical load predictions Some potential impacts on design requirements due to finite in flight availability of the MLC system are illustrated (Author)

A79 29050 * # Applications of Laplace transform methods to airfoil motion and stability calculations J W Edwards (NASA, Flight Research Center Edwards Calif) In Structures, Structural Dynamics, and Materials Conference 20th St Louis Mo April 4 6, 1979, Technical Papers on Structures and Materials New York American Institute of Aeronautics and Astronautics, Inc 1979 p 465 481 32 refs (AIAA 79 0772)

This paper reviews the development of generalized unsteady aerodynamic theory and presents a derivation of the generalized Possio integral equation Numerical calculations resolve questions concerning subsonic indicial lift functions and demonstrate the generation of Kutta waves at high values of reduced frequency subsonic Mach number or both The use of rational function approximations of unsteady aerodynamic loads in aeroelastic stabil ity calculations is reviewed and a reformulation of the matrix Pade approximation technique is given Numerical examples of flutter boundary calculations for a wing which is to be flight tested are given Finally, a simplified aerodynamic model of transonic flow is used to study the stability of an airfoil exposed to supersonic and subsonic flow regions (Author)

A79-29051 # Accelerated basic loads analysis J G Lewolt and D A O'Keefe (Lockheed California Co , Burbank, Calif) In Structures, Structural Dynamics, and Materials Conference, 20th, St Louis, Mo , April 4 6, 1979, Technical Papers on Structures and Materials New York, American Institute of Aeronautics and Astronautics Inc , 1979, p 482 489 (AIAA 79 0737)

The paper has briefly described an independent development program designed to accelerate the loads analysis cycle through substantial improvements in the time spans of external loads analysis cycles A systematic approach was adopted which encompassed practically all aspects of primary structure criteria and loads analysis, including the detailed identification of subtasks time spans, flow paths, data input and output schedules and critical paths Analysis tools and computer programs were reviewed and improved The improvements involved consolidation of programs and development of new programs Improved procedures and programs were imple mented including the generation of improved management tools and policies While the primary objective of the independent develop ment program was to improve time spans it also provided significant reductions in manhours and improvements in loads analysis S D

A79 29052 # On the design of thin subsonic airfoils W C Chin (Boeing Commercial Airplane Co Aerodynamics Research Group Seattle, Wash) *ASME Transactions, Journal of Applied Mechanics,* vol 46 Mar 1979 p 6 8 5 refs

The inverse problem which determines an airfoil geometry given some specified surface pressure is considered in the subsonic, thin airfoil limit The full governing equations are expanded in powers of the thickness ratio and solved to second order The two sequential formulations contain free parameters which are fixed by invoking 'Kutta type' conditions related to trailing edge closure The correct ness of the basic approach is demonstrated by using known classical examples for the simpler first order problem (Author)

A79 29096 # Method for studying experimentally the aero dynamic interference of small secondary structures with a lifting surface (Metodika eksperimental nykh issledovanii aerodinamicheskoi interferentsii nebol'shikh nadstroek s nesushchei poverkhnost'iu) M D Brodetskii, A I Maksimov, and A M Kharitonov (Akademiia Nauk SSSR Institut Teoreticheskoi i Prikladnoi Mekhaniki Novo sibirsk USSR) *Akademiia Nauk SSSR, Sibirskoe Otdelenie Izvestiia Seriia Tekhnicheskikh Nauk,* Oct 1978 p 81 86 In Russian

A procedure for carrying out wind tunnel studies of the aerodynamic characteristics of small secondary structures on aircraft and their interference with the lifting surface at supersonic velocities is described The aerodynamic characteristics of the secondary structures are measured by means of tensometric weighrs by taking into account the pressure distribution on the surface of the model in the interference zone The secondary structures are placed next to the lifting surface with a small gap between the two for the tensometric measurements which necessitates a correction to the base pressure and drag in the base section of the secondary structures Results of systematic studies conducted on schematic models of a flat half wing at Mach number 2 5 and Reynolds number of 28 million are discussed P T H

A79 29120 # Accuracy of determination of aromatic hydro carbon content in jet fuels by the sulfuric acid method (Dostover nost opredeleniia soderzhaniia aromaticheskikh uglevodorodov v reaktivnykh toplivakh sernokislotnym metodom) V N Zrelov, L V Kvasnaia, N G Postnikova, and L L Kalinin *Khimiia i Tekhnologiia Topliv i Masel,* no 3, 1979 p 7 9 In Russian

The aromatic hydrocarbon content in jet fuels T 1 and TS 1 was measured by sulfurizing them with sulfuric acid in the weight con centration range 90 102% The results were found not to be reliable in view of the partial sulfurization of paraffin naphthalene hydro carbons by sulfuric acid with concentration of 98 5% P T H

A79-29121 # Effectiveness of the antioxidation additive ionol in jet fuels (Effektivnost' antiokislitel noi prisadki ionol v reaktivnykh toplivakh) Ia B Chevtkov E P Seregin, R M Berezina E A Kunina and T I Kirsanova *Khimiia i Tekhnologiia Topliv i Masel* no 3, 1979, p 9 11 9 refs In Russian

The effect of the antioxidation additive ionol, used in the amount of 0 003 wt % in water purified jet fuels, was studied The fuels, containing less than 0 02 wt % sulfur are thermally stable Only products of hydrocarbon self oxidation which can be dissolved in the fuel are formed By the introduction of ionol the formation of even soluble oxidation products is eliminated at temperatures less than 100 C P T H

A79-29122 # Measurement of emulsion water content in aviation fuels (Ob izmerenii soderzhaniia emul'sionnoi vody v aviatsionnykh toplivakh) S I Maksimov, M Ia Daikhin, I Kh Mamedova Sh I Seidov, A Ia Zeinalov, and E G Airapetov (NIPINKhA USSR) *Khimiia i Tekhnologiia Topliv i Masel,* no 3 1979 p 50 52 In Russian

The calcium hydride method of determining emulsion water content in jet fuels in accordance with the GOST 8287 57 standard was evaluated by obtaining exact emulsion water content by separating the emulsion water with the aid of a small size immersion type filter A total of 153 specimens of water fuel emulsions prepared by a method simulating the actual process of emulsion formation were tested The metrological characteristics of the method were determined as follows (1) rms error = 0 00017% humidity (2) reduced error = 4 3 rel % In another experiment it was found that the mechanism $CaH_2 + Ca(OH)_2 = CaO + 2H_2$ is insignificant P T H

A79 29124 # Method of determining precipitates formed during use and storage of synthetic oils (Metod opredeleniia osadkov, obrazuiushchikhsia pri rabote i khranenii sinteticheskikh masel) I A Rubinshtein, E A Popova, and G T Novosartov *Khimiia i Tekhnologiia Topliv i Masel,* no 3 1979, p 55 57 In Russian

The paper describes a method of determining the content of precipitates in synthetic oils oxidized under operating and storage conditions by which the amounts of undissolved precipitates and dissolved precipitates are determined separately The undissolved precipitates are removed by successive centrifugation, the dissolved

ones are obtained by isooctane treatment followed by centrifugation For several different oils, the variation of the dissolved fraction and the undissolved fraction of precipitates with oil service time could be studied P T H

A79-29151 # Aerohydroelastic opening of a shell in unsteady flow (Pro aerogidropruzhne rozkrittia obolonki u nestatsionarnomu pototsi) I T Selezov A K Kuchugura, and N K Tsiganov (Akademiia Nauk Ukrains koi RSR, Institut Gidrome khaniki, Kiev Ukrainian SSR) *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A Fiziko Matematichni ta Tekhnichni Nauki* Dec 1978, p 1116 1120 17 refs In Ukrainian

The aerohydrodynamics of opening shells is considered with particular reference to problems of parachute dynamics The theoretical approach used is an approximate one with reliance on existing experimental data, simplified equations of shell theory, and equations of aerohydrodynamics B J

A79 29352 # Analysis of bird strikes reported by European airlines 1972 to 1975 J Thorpe (Civil Aviation Authority, Safety Date Unit Redhill Surrey England) In World Conference on Bird Hazards to Aircraft 3rd Paris France October 25 27 1977 Proceedings Paris, Inspection Generale de l Aviation Civile, 1977 p 16 50 Discussion, p 51 52

The strikes reported throughout the world between 1972 and 1975 by airlines from 14 European countries have been analysed The analysis includes the annual rate for each country, and overall rates for aircraft types and for aerodromes all based on aircraft movements It also covers bird species month of year and time of day airspeed and altitude flight stage, effect of strike cost estimates and airlines affected An Appendix contains details of worldwide accidents involving loss of life/write off of aircraft The results of the analysis are discussed some problem areas highlighted, and recommendations proposed (Author)

A79 29353 # Birdstrike hazards to turbine powered aircraft J L Seubert (U S Fish and Wildlife Service Denver Wildlife Research Center Denver Colo) In World Conference on Bird Hazards to Aircraft 3rd Paris France October 25 27, 1977 Proceedings Paris Inspection Generale de l Aviation Civile 1977 p 53 68 31 refs

With the large number of birds already in existence and increases occurring in populations of certain species particularly hazardous to aircraft it appears that increasing losses of aircraft and people will inevitably follow unless suitable countermeasures are implemented Since 1960 two large turboprops a jumbo jet two small turboprops and eight small jets have been lost or seriously damaged by bird strikes all the incidents except two were the result of birds ingested into engines The paper focuses on problem identification and monitoring of bird strike hazards, bird management plans for airports training information and public relations ecological investigations and other related topics At certain times and places birds are found to be very hazardous to aircraft particularly small turbine powered aircraft Widescale remedial programs are indispensable in eliminating loss of aircraft and human lives S D

A79 29354 # Some statistical data on birds strike to aircraft and helicopters over the territory of the Soviet Union A I Rogachev and O K Trunov (Aeroflot, National Research Institute for Civil Aviation Airport Sheremetyevo, USSR) In World Conference on Bird Hazards to Aircraft 3rd Paris France, October 25 27 1977, Proceedings Paris Inspection Generale de l'Aviation Civile 1977 p 104 112

The paper reviews bird hazard to aircraft and helicopters over the territory of the Soviet Union for the 1975 1976 period The discussion centers around the characteristics of the ornithological situation in USSR Tables of bird aircraft collisions are presented relative to types of aircraft, flight altitudes and bird sizes seasonal occurrence and day periods, and flight altitudes and day periods The data presented provide insight into the gravity of bird strike to aircraft S D

A79 29355 # Some behavioural aspects of airfield bird control T Brough (Ministry of Agriculture Fisheries and Food Pest Infestation Control Laboratory Guildford Surrey England) In World Conference on Bird Hazards to Aircraft 3rd Paris France October 25 27, 1977 Proceedings Paris Inspection Generale de l Aviation Civile 1977, p 117 121 7 refs

Birds are capable of some degree of learning and the adaptability of their behavior tends to blunt the effectiveness of any measures taken to keep them away from airfields The paper deals with the assessment of the airfield bird problem relevant remedial action employment of specialist bird controllers, the need for knowledge, information and understanding, and the need for vigilance enthusiasm and encouragement It seems that the only solution to the bird strike problem on airfields is the application of whatever habitat management techniques can be afforded combined with continuous monitoring of the bird situation and the persistent use of bird scaring measures whenever necessary S D

A79 29356 # Ecological interpretation of bird aircraft collisions on the Nice Côte d'Azur Airfield (Interpretation ecologique des collisions oiseaux aeronefs survenues sur l Aerodrome de Nice Côte d Azur) M Laty (Centre Regional de Navigation Aerienne du Sud Est Aix en Provence France) In World Conference on Bird Hazards to Aircraft 3rd, Paris France October 25 27 1977 Proceedings Paris Inspection Generale de l'Aviation Civile 1977 p 122 136 In French

A79 29357 # Airport project Munich II Aspects on the economic utilization of the airport area under consideration of the bird strike problem J Maron (Flughafen Munchen GmbH Munich West Germany) In World Conference on Bird Hazards to Aircraft 3rd, Paris France October 25 27, 1977 Proceedings Paris Inspection Generale de l Aviation Civile, 1977, p 140 145

Munich Airport II is projected to be located about 15 miles north of the city The paper deals with the way in which the future airport area will be cultivated and economically used Three problem areas are discussed (1) the proper outward appearance of all zones, which is of prime importance within a cultivated landscape, the economy of the cultivation measures in terms of how the cost and the economic use of the area can be balanced, and (3) prevention of bird strikes with particular reference to the limits of the bird strike problem and the economic use S D

A79 29358 # Planning and control of bird hazard reduction at airports in the Transport Canada system R B Campbell (Transport Canada Airport Facilities Branch Ottawa Canada) In World Conference on Bird Hazards to Aircraft 3rd Paris France October 25 27, 1977 Proceedings Paris Inspection Generale de l Aviation Civile, 1977, p 146 162

The paper describes how bird hazard research is applied to the Transport Canada's decentralized system of management This decentralized airport system comprises two types of management viz management at the corporate level and management at the site of operations Attention is given to the division of management responsibilities in Transport Canada avoidance of bird hazards by effective strategic planning, and avoidance of bird hazards by effective inspection system Topics of interest include zoning and land use planning airport operational standards for bird hazard control bird strike reporting procedure and features of airport site inspection visit S D

A79 29359 # The use of falcons to disperse nuisance birds at Canadian airports - An update H Blokpoel (Canadian Wildlife Service Ottawa Canada) In World Conference on Bird Hazards to Aircraft 3rd, Paris France October 25 27, 1977 Proceedings Paris, Inspection Generale de l'Aviation Civile 1977, p 179 187 5 refs

A79 29360 # Equipment and methods for dispersing birds used on French airfields J L Briot (Direction Generale de l'Aviation Civile Service Technique de la Navigation Aerienne Paris France)

In World Conference on Bird Hazards to Aircraft 3rd, Paris, France October 25 27, 1977, Proceedings Paris, Inspection Generale de l Aviation Civile 1977, p 188 198

The scaring equipment presently used on French airfields are described along with two efficient methods of bird dispersal Two types of bird scaring equipment are discussed viz acoustic bird scaring equipment and pyrotechnic devices stationary, semimobile and mobile versions are considered The bird dispersal methods aim at removing wood pigeons and raptors S D

A79 29361 # The incidence of bird strikes by aeroplanes at Entebbe Airport J J Gwahaba (Makerere University Kampala Uganda) In World Conference on Bird Hazards to Aircraft 3rd Paris, France October 25 27, 1977 Proceedings
Paris Inspection Generale de l Aviation Civile 1977 p 199 208 5 refs

The paper summarizes the results of long term recording of bird aircraft collisions over Entebbe Airport The discussion concerns the frequency of occurrence, time of day, and seasonal incidence An average of four incidents per year is observed Practically all the incidents occurred during daytime Most incidents took place between December and May The birds responsible for the incidents are not all palearctic migrants Kites are responsible for a higher number of incidents than any other species of bird S D

A79 29362 # Radar and bird aircraft collisions F R Hunt (National Research Council Electrical Engineering Div Ottawa Canada) In World Conference on Bird Hazards to Aircraft 3rd Paris France October 25 27 1977 Proceedings
Paris Inspection Generale de l'Aviation Civile, 1977, p 235 239

Two sets of rules regarding the relationship between radar observed data and bird aircraft collision risk are presented The first set covers broad front migration of small birds while the second set concerns large flocks of water fowl An illustrative example for each set is provided using radars currently used in Canada S D

A79 29363 # Bird strikes An increasingly important problem in aviation safety A Roed In World Conference on Bird Hazards to Aircraft 3rd, Paris France October 25 27 1977, Proceedings Paris Inspection Generale de l Aviation Civile 1977, p 293 301

The paper examines bird strikes as a factor in aviation safety Attention is given to the present aviation safety level expected safety improvements, and remaining accident causes After pointing out the fact that a main task of flight safety work is to identify the remaining unsafe practices the author shows how to do it The discussion suggests that it is possible to design extremely safe aircraft with system redundancies that make the probability of technical failures of the aircraft exceedingly remote S D

A79 29364 # Bird strike on medium/large civil fan engines D Marsh In World Conference on Bird Hazards to Aircraft 3rd, Paris, France, October 25 27 1977 Proceedings
Paris Inspection Generale de l Aviation Civile, 1977 p 302 319, Discussion p 320

Both the present generation large fan engine and the medium size engine designs now being evolved are subject to foreign object damage including damage caused by bird strike The paper deals with the birdstrike history of a present generation large fan engine the Rolls Royce RB 211 To date, the service record of resistance to bird strike damage has been very good The description of the ongoing bird ingestion research program is concerned with engine parts that can be affected by bird strikes, damage and failure modes test and analytical techniques S D

A79 29365 # Bird strikes to transport aircraft jet engines J Thorpe (Civil Aviation Authority Safety Date Unit, Redhill Surrey, England) In World Conference on Bird Hazards to Aircraft 3rd Paris France, October 25 27, 1977 Proceedings
Paris Inspection Generale de l'Aviation Civile 1977, p 321 336

Data from four European countries for the years 1973 to 1976 on bird strikes to transport aircraft jet engines has been analysed The factors affecting strikes, such as engine location and intake area have been examined The relative ability of differing engine types to withstand bird strikes has also been considered (Author)

A79 29366 # USAF bird impact resistant windshield technology program R E Wittman (USAF Flight Dynamics Laboratory Wright Patterson AFB Ohio) In World Conference on Bird Hazards to Aircraft 3rd, Paris France October 25 27 1977 Proceedings Paris Inspection Generale de l Aviation Civile 1977 p 337 339 Discussion p 340

The paper discusses a near term/long term program for the development of bird impact resistant windshield technology The near term goal is to demonstrate a capability to empirically develop bird impact resistant transparency systems for existing operational aircraft The long term goal is focused on solutions through the development of bird impact analytical design tools and through thorough consideration of aircrew-oriented optical needs and owner oriented life cycle cost problems Achievements to date are noted S D

A79 29367 # Plane as a deterrent and attractant V E Jacoby In World Conference on Bird Hazards to Aircraft, 3rd, Paris, France October 25 27, 1977 Proceedings Paris, Inspection Génerale de l'Aviation Civile, 1977 p 345 350 Discussion p 351

The influence of deterrent aircraft features on birds particularly during nighttime through the use of flashing light, illumination of the front part, laser scanning etc is discussed At airports birds learn to avoid collisions The most hazardous are the birds which appear for the first time on the aircraft flight path The probability of bird strikes increases substantially at night. Intensification of the deterrent feature of an aircraft during nighttime is due to the fact that a bird discovers the aircraft from a great distance so that it has enough time to fly away and avoid collision Landing lights attract birds at night for a possible bird to aircraft collision, it is recommended to switch on the landing lights at the last moment. S D

A79 29368 # The use of lights in reducing bird strikes J Thorpe (Civil Aviation Authority, Safety Date Unit Redhill Surrey England) In World Conference on Bird Hazards to Aircraft 3rd Paris France October 25-27, 1977, Proceedings
Paris Inspection Generale de l'Aviation Civile 1977 p 352 357, Discussion p 358

The paper analyzes the results of a special birdstrike reporting program implemented in the United Kingdom in 1976 and devised to evaluate the effect of using lights on birds at all times (daylight and night) in relation to aircraft over 5700 kg About 50 percent of aircraft movements during daylight and about 95 percent at night are with lights on When the use of lights is known, the report indications show that 73 percent of bird strikes in daylight occur during the 50 percent of movements when it is believed lights are not used, and at night 21 percent occur during the 5 percent of movements when lights are not used This suggests that the use of lights may reduce but not prevent bird strikes Lights used in daylight appear to be more effective against lapwings than against gulls S D

A79 29369 # Bird control - The experience of one aerodrome In World Conference on Bird Hazards to Aircraft 3rd, Paris, France, October 25 27, 1977, Proceedings Paris Inspection Générale de l'Aviation Civile, 1977, p 359 370, Discussion, p 371

The paper is concerned with an operational assessment of bird control as observed by ATC and flying staff at the airport of Boscombe Down UK Following a review of the methods used at Boscombe Down - falconry, vans equipped with Hi Fi equipment emitting distress calls, cartridge crackers, ploughing and use of long grass the paper concludes that falconry service is one of the several very effective methods available In particular, the use of falconry service has produced substantial financial savings in addition to a contribution to flight safety S D

A79 29370 # **Evaluation of an inquiry to pilots concerning their knowledge of the bird strike problem and experience of strikes** N O Lindberg and T Dahl In World Conference on Bird Hazards to Aircraft, 3rd Paris, France October 25 27, 1977, Proceedings Paris, Inspection Generale de l Aviation Civile, 1977, p 372 377 Discussion p 378

Results are presented of an opinion survey conducted on a national scale with a view to reveal what pilots think about bird strikes and pertinent preventive techniques This questionnaire based survey demonstrated that apparently only 7 percent of the pilots had never experienced a bird strike, many pilots have little or no knowledge of the work done to improve aircraft protection against bird strikes, and that garbage dumps were rightly assessed to be the main cause of birds' presence and were considered as a serious hazard It is recommended to provide better education to pilots and ATC controllers as to bird species, impact forces, and airworthiness requirements S D

A79 29377 # **Effect of hub and tip annular flow blockage on the performance of a single stage axial flow compressor** I K Shatalov (Universitet Druzhby Narodov, Moscow, USSR) and W F O'Brien, Jr (Virginia Polytechnic Institute and State University Blacksburg, Va) In International Symposium on Air Breathing Engines, 4th, Orlando Fla April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics, Inc , 1979 p 3 8 7 refs (AIAA 79 7001)

The effect of part-span circumferential inlet blockage on the performance of a single-stage axial flow compressor was experimentally investigated Flow through the inlet guide vanes of the machine was blocked over 25 percent of the span at the tip and at the hub of the vanes When the machine was operated with an unblocked inlet surge occurred at reduced mass flows Both hub and tip blockage were found to stop pre existing surge in the compressor and to prevent the development of surge when the blockage plates were in place as mass flow was reduced For the machine tested hub blockage was found to produce less performance penalty Measurements of surface pressures on the rotor blades and dynamic pressure fluctuations behind the rotor row were included in the investigation (Author)

A79 29378 # **Asymmetric distortion generation in a variable height annulus** R E Peacock, M A El Attar and G D Robinson (Cranfield Institute of Technology Cranfield, Beds England) In International Symposium on Air Breathing Engines 4th Orlando Fla , April 1 6 1979 Proceedings New York American Institute of Aeronautics and Astronautics Inc 1979 p 9 15 5 refs (AIAA 79 7002)

The paper addresses the problem of producing a particular pressure distortion at the compressor face, but created by a remotely sited distortion generating screen Using a bellmouth intake with central nose bullet as the example a method of screen design is proposed which with small perturbation assumptions superimposes a generated distortion upon the undistorted potential flow solution of the developed annulus In the case studied a circumferential sine wave velocity distortion in the flow resulting from a pressure distribution convected along the streamlines led to a design of screen whose porosity varied both in the circumferential and meridional planes With minor modification to the basic design the desired circumferential velocity distortion was generated within close limits, thus validating by experiment the design technique (Author)

A79 29379 # **Effects of inlet distortions on a multi stage compressor** T Tamaki and S Nagano (Ishikawajima Harima Heavy Industries Co Ltd Tokyo Japan) In International Symposium on Air Breathing Engines 4th, Orlando Fla April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 17 24 6 refs (AIAA 79 7003)

An investigation was conducted to determine the effects of the total pressure distortion on a multi stage compressor Performance of a five stage transonic compressor with distorted inflows is investigated experimentally The compressor was tested with various inlet distortions, i e radial, circumferential and combined distortions Overall performance (pressure ratio weight flow rate and stable operating range) was investigated and compared with the results with clean inlet flow The performance prediction with distorted inflows was also conducted and compared with the experimental results The off design performance calculation method using the streamline curvature method can be effective to predict the performance with radial distortions while the parallel compressor model is not sufficient to predict the performance with circumferential distortions though it may be able to estimate the loss of the surge pressure ratio (Author)

A79 29380 # **Air inlet engine matching problems of a jet aircraft** S M Ramachandra K Sudhakar P V K Perumal P Jayasimha (Hindustan Aeronautics Ltd , Bangalore, India) In International Symposium on Air Breathing Engines 4th Orlando Fla April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics, Inc 1979, p 25 31 11 refs (AIAA 79 7004)

The paper describes the redesign of an air channel which initially was responsible for flow induced catastrophic inlet guide vane vibration/flutter Theoretical studies were based on the Rolls Royce definition of distortion indices describing flow quality in an air channel Redesign was started with a dynamic pressure survey at the compressor face which indicated severely fluctuating large negative pressures Continuous in flight pressure measurements were also made, and the improvements in the vibration levels as the intake was modified were recorded P T H

A79 29381 # **A critical review of performance monitoring systems on the basis of the experience obtained from routine applications** M Caprili R Lazzeretti (Pisa Universita, Pisa, Italy), B Signori (Alitalia, Rome Italy) and F Traversa In International Symposium on Air Breathing Engines 4th Orlando Fla April 1 6 1979, Proceedings New York American Institute of Aeronautics and Astronautics Inc 1979 p 35 44 Consiglio Nazionale delle Ricerche Contract No 77,01381 07 (AIAA 79 7006)

The paper discusses an airline's experience with its engine condition monitoring system Results of a statistical evaluation of the reliability of the system are discussed Some new engine condition monitoring techniques are mentioned, including the calculation of the outside air temperature limit (OATL) P T H

A79 29382 # **A technique for engine maintenance cost forecasting** M J Day (Rolls Royce Ltd Derby England) and R S Stahr (Rolls Royce, Inc , Seattle Wash) In International Symposium on Air Breathing Engines 4th, Orlando, Fla April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics Inc 1979 p 45 52 (AIAA 79 7007)

A method of forecasting engine maintenance costs based on the lives of individual component parts and the work done on each module is described The cost per flight hour for each component is determined from the selling price and the component replacement distribution charactertistic Effects of operation derate ambient temperature and flight length are taken into account P T H

A79 29383 * # **Effect of broadened specification fuels on aircraft engines and fuel systems** R A Rudey (NASA Lewis Research Center Cleveland, Ohio) In International Symposium on Air Breathing Engines, 4th Orlando, Fla April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics, Inc 1979 p 53 69 23 refs (AIAA 79 7008)

A wide variety of studies on the potential effects of broadened specification fuels on future aircraft engines and fuel systems are summarized The compositions and characteristics of aircraft fuels that may be derived from current and future crude oil sources are described and the most critical properties that may affect aircraft engines and fuel systems are identified and discussed The problems that are most likely to be encountered because of changes in selected fuel properties are described and the related effects on engine performance component durability and maintenance and aircraft

fuel system performance are discussed The ability of current technology to accept possible future fuel specification changes is discussed and selected technological advances that can reduce the severity of the potential problems are illustrated (Author)

A79 29384 # Testing to assess the affect of degraded fuel specifications on the cold start ability of a T63 A 700 engine W L Macmillan (Department-of National Defence Ottawa Canada) In International Symposium on Air Breathing Engines, 4th Orlando Fla April 1 6, 1979 Proceedings New York American Institute of Aeronautics and Astronautics, Inc , 1979 p 71 77 7 refs (AIAA 79 7009)

In the interests of jet fuel availability the Canadian commercial wide-cut fuel specification has recently been relaxed by increasing the freeze point An increased freeze point implies an increased low temperature viscosity and associated cold starting difficulties To identify the amount of cold start degradation to be expected with such fuels, the Canadian Forces commissioned testing to examine the cold start ability of an Allison T63 A 700 turboshaft engine using four fuels ranging from typical kerosene Jet A 1 to NATO wide cut F 40 The two intermediate fuels were wide cut fuels blended to have specific freeze points agreeing with the new fuel specifications For the engine under test, the effect of fuel properties on cold start ability was evident with the relaxed wide cut fuel producing a 20 C degradation in starting ability compared to the typical NATO F 40 fuel (Author)

A79 29385 # A new technique to compute installed jet engine thrust Applications to trimming for economic and operation al benefits G B Mackintosh and J E Dawson (Computing Devices Co , Ottawa Canada) In International Symposium on Air Breathing Engines 4th Orlando Fla , April 1 6, 1979, Proceedings New York American Institute of Aeronautics and Astronautics Inc 1979 p 79 88 6 refs (AIAA 79 7010)

Technology and equipment have been developed to compute the gross thrust of an aircraft jet engine based on measurement of pressures in the engine tailpipe This computation can be performed for either bare or installed engines J85 5 engines installed in T 38A aircraft exhibit large variations in installed gross thrust Thrust computing support equipment can be used to trim the installed engines to a selected gross thrust level As a result average exhaust gas temperature for the fleet can be reduced without affecting mission performance reliability The reduction in engine operating tempera ture will produce operation and maintenance cost savings estimated at $6,130 000 annually for the USAF T 38A fleet The technology is generally applicable to afterburning turbojet and turbofan engines and has also been demonstrated on Olympus 593, J79 TF30 and F100 engines (Author)

A79 29386 * # Characteristics of aeroelastic instabilities in turbomachinery NASA full scale engine test results J F Lubomski (NASA, Lewis Research Center, Cleveland, Ohio) In International Symposium on Air Breathing Engines, 4th, Orlando Fla April 1 6, 1979 Proceedings New York American Insti tute of Aeronautics and Astronautics Inc , 1979 p 91 102 8 refs (AIAA 79 7011)

Several aeromechanical programs have been conducted in the NASA/USAF Joint Engine System Research Programs The scope of these programs the instrumentation data acquisition and reduction, and the test results are discussed Data pertinent to four different instabilities were acquired two types of stall flutter choke flutter and a system mode instability The data indicates that each instability has its own unique characteristics These characteristics are described (Author)

A79 29387 # Vibration measurements on planetary gears of aircraft turbine engines M Botman (Pratt and Whitney Aircraft of Canada Ltd , Longueuil, Quebec Canada) In International Sym posium on Air Breathing Engines 4th Orlando Fla , April 1 6 1979 Proceedings New York American Insti tute of Aeronautics and Astronautics Inc 1979, p 103 110 10 refs (AIAA 79 7012)

Planetary reduction gear stages are an efficient compact, and lightweight means of speed reduction and are therefore, used in many aero turbine engines The continuing demand for uprated or new higher powered designs requires a good understanding of the design factors that play a role in the dynamic gear loads and motions The theoretical dynamic analysis of a planetary gear stage is quite complex due to the multiple, nonlinear, gear meshes Dynamic measurements taken on PT6 reduction gear boxes over a number of years are reviewed Peculiar behavior found in these tests is discussed, such as load sharing among planets responses due to gear errors and a dynamic instability (Author)

A79 29389 # The balance of flexible rotors and their possible use in aero engines V Bruno (Alfa Romeo S p A , Naples, Italy) In International Symposium on Air Breathing Engines, 4th Orlando, Fla April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 117 120 (AIAA 79 7014)

The paper examines the principle of dynamic balancing of flexible rotors Recent improvements achieved by introduction of multiplane, multispeed balancing techniques aided by computers are described The possibilities opened by these improvements for use of flexible rotors on aircraft turbine engines are discussed P T H

A79 29390 # A thermodynamic investigation of the mixer for noise reduction based on the work availability function 'exergy' M Berchtold (Eidgenossische Technische Hochschule, Zurich, Switzerland) In International Symposium on Air Breathing Engines, 4th Orlando, Fla April 1 6, 1979 Proceedings New York American Institute of Aeronautics and Astronautics, Inc , 1979, p 123 131 6 refs (AIAA 79 7017)

The concept of exergy is reviewed and is applied to the evaluation of the thermodynamic cycle of a bypass jet engine gas turbine with integrated mixer for noise reduction It is shown that the sum total of all exergy losses regarding thrust power output for the engine with mixer is less than for an otherwise identical engine without mixer which therefore accounts for the known high performance of the engine with mixer P T H

A79-29391 * # Measurements and predictions of flyover and static noise of an afterburning turbofan engine in an F 111 airplane F W Burcham Jr (NASA Flight Research Center Propulsion Controls Branch Edwards Calif) In International Symposium on Air Breathing Engines, 4th Orlando Fla , April 1 6, 1979 Proceed ings New York, American Institute of Aeronau tics and Astronautics, Inc 1979 p 133 145 13 refs (AIAA 79 7018)

The noise of the TF30 afterburning turbofan engine in an F 111 airplane was determined from static (ground) and flyover tests Exhaust temperatures and velocity profiles were measured for a range of power settings Comparisons were made between predicted and measured jet mixing, internal and shock noise It was found that the noise produced at static conditions was dominated by jet mixing noise and was adequately predicted by current methods The noise produced during flyovers exhibited large contributions from internal ly generated noise in the forward arc For flyovers with the engine at nonafterburning power the internal noise shock noise and jet mixing noise were accurately predicted During flyovers with afterburning power settings, however, additional internal noise believed to be due to the afterburning process was evident its level was as much as 8 decibels above the nonafterburning internal noise (Author)

A79 29392 # Double recirculation zone two-stage com bustor B G A Sjoblom and K A Zetterstrom (Volvo Flygmotor AB Trollhattan, Sweden) In International Symposium on Air Breathing Engines 4th, Orlando, Fla , April 1 6 1979, Proceedings New York American Institute of Aeronautics

and Astronautics, Inc 1979 p 149 158 8 refs Research sponsored by the Styrelsen for Teknisk Utveckling and Royal Swedish Air Force (AIAA 79 7019)

A new concept for two stage low emission combustion requiring moderate modifications of a conventional gas turbine combustor has been investigated An air cooled 'zone divider' was installed into a standard flame tube Air holes were rearranged in such a way that two recirculation zones were formed, one upstream and one downstream the 'zone-divider' Fuel was fed separately to each zone through the air holes by means of air blast atomizers The combustor was tested at conditions corresponding to four different engine power settings and effect of primary secondary fuel flow split on emissions was investigated A simultaneous reduction of all emissions compared to a reference combustor was obtained when the primary zone was operated fuel rich The regulations were met with respect to unburned hydrocarbons Carbon monoxide emission was close to the goal whereas oxides of nitrogen were reduced 25 30% and still require further reduction (Author)

A79 29394 # Experimental study on the burning out of flameholders C Y Yeh and J S Chang (Peking Institute of Aeronautics and Astronautics Peking Communist China) In International Symposium on Air Breathing Engines 4th Orlando Fla, April 1 6 1979, Proceedings New York American Institute of Aeronautics and Astronautics, Inc 1979, p 169 176 (AIAA 79 7021)

Rench tests indicate that on certain conditions the burning out of flameholders is related to the fact that abnormal flame is stably attached to nonstreamline bodies upstream of flameholders at the starting of combustor Based on some simplified assumptions, the paper analyzes the features of unsteady flow at the starting of combustor and points out that flame attaching occurs due to instantaneous reverse flow and burning out of flameholder due to stable existence of flame attaching Experiments on a test apparatus recorded the phenomenon of instantaneous reverse flow to cause flame attaching and the process of burning out caused by flame attaching and demonstrated that the occurrence of flame attaching is closely related to the stream velocity at combustor entrance and the strength of compression wave formed (Author)

A79 29395 # Numerical modelling of the combustion of fuel sprays in three dimensional can combustors V Ganesan (Indian Institute of Technology Madras, India) and D B Spalding (Imperial College of Science and Technology London England) In International Symposium on Air Breathing Engines 4th, Orlando Fla April 1 6, 1979, Proceedings New York, American Institute of Aeronautics and Astronautics Inc 1979, p 177 186 7 refs (AIAA 79 7022)

Predictions of hydrodynamic and thermodynamic properties of a flow in a three dimensional can combustor are presented The flow is three dimensional, steady, incompressible, turbulent and chemically reacting The predictions are obtained by the numerical solution of the transport equations for the components of the mean velocity the pressure the kinetic energy of turbulence and its dissipation rate, the stagnation enthalpy the concentrations of fuel droplets in five size ranges and the concentration of gaseous fuel before and after the occurrence of chemical reaction In the fuel spray analysis account is taken for vaporization plus combustion processes around the droplets The present numerical solution procedure provides a useful tool for investigating gas turbine combustion chamber problems (Author)

A79 29397 # Transonic boundary layer on compressor stator blades as calculated and measured in wind tunnel G Meauze (ONERA Châtillon sous-Bagneux Hauts de Seine France) In International Symposium on Air Breathing Engines 4th Orlando Fla April 1 6 1979, Proceedings New York American Institute of Aeronautics and Astronautics, Inc 1979 p 199 207 7 refs (AIAA 79 7025 ONERA TP no 1979 25)

Tests on stator blade cascades were conducted to provide experimental background for the validation of turbulent boundary layer calculations Emphasis is put on the prediction of turbulent separation that induces the major fraction of the losses An integral method was used for predicting the separation point It requires knowledge of the boundary layer parameters downstream of the transition point Agreement with test results is satisfactory in the moderate Mach number range and with mild separation P T H

A79 29399 # Diffusers for supersonic intakes The dependence of conical diffuser performance on inlet flow conditions W A Kamal (Alexandria University Alexandria, Egypt) and J L Livesey (Salford University Salford, Lancs, England) In International Symposium on Air Breathing Engines, 4th Orlando Fla April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics Inc 1979 p 219 226 9 refs Ministry of Defence of England Contract No AT/2101/013/SRA (AIAA 79 7027)

Experimental results are presented for the variation of the diffuser pressure recovery, total pressure loss and the nonuniformity of its outlet flow with diffuser inlet conditions specified in terms of the mean inlet Mach number, Reynolds number, a boundary layer blockage parameter and a single integral parameter describing the inlet turbulence structure Three conical diffusers with total angles of 5 12, and 20 deg and of area ratio up to 4 were tested for an intake Mach number of 1 4 and an inlet pipe length up to 8 diameters The junction between the parallel entry pipe and the diffuser cone is sharp and the diffuser inlet conditions are evaluated from measurements on a plane 1 5 diameters upstream of the sharp transition The results presented in Parts I and II of the paper are combined to optimize the shock boundary layer interaction parameters for an efficient intake system (Author)

A79 29401 # An extension of the classical cascade model to a 3D model for blade-hub and blade-casing interaction Experiments and calculations J H Renken (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Antriebstechnik, Cologne, West Germany) In International Symposium on Air Breathing Engines 4th, Orlando, Fla, April 1 6 1979, Proceedings New York, American Institute of Aeronautics and Astronautics, Inc 1979 p 235-239 (AIAA 79 7029)

In the paper an extension of the classical cascade model to a three-dimensional model for blade-hub and blade-casing interaction is proposed The proposal is based on the results of fully three-dimensional panel method calculations for the incompressible flow in a straight cascade having contracted endwalls with convex or concave curvature The results of the panel method calculations are verified by means of flow measurements in a corresponding three-dimensional cascade (Author)

A79 29402 # Aerodynamic development and performance of the CF6-6/LM2500 compressor J F Klapproth M L Miller, and D E Parker (General Electric Co Aircraft Engine Group Evendale Ohio) In International Symposium on Air Breathing Engines, 4th Orlando Fla April 1 6 1979, Proceedings New York American Institute of Aeronautics and Astronautics, Inc 1979 p 243 249 (AIAA 79 7030)

The aero design and development of the high pressure ratio single spool compressor for the CF6/6 and LM2500 engines is described This compressor is a major component in the highly efficient gas generator core widely used in aircraft engines in the CF6 6 and in marine and industrial applications as the LM2500 engine The aero development background the compressor flow path and blading description and the aero design are summarized The compressor performance characteristics are described and the variable geometry necessary to obtain satisfactory starting and part power operation is discussed (Author)

A79 29403 # A wind tunnel investigation into the effect of errors in blade setting on the stalling performance of a compressor cascade R M El Taher (Cairo University Cairo Egypt) In International Symposium on Air Breathing Engines, 4th Orlando Fla , April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics Inc , 1979 p 251 258 7 refs (AIAA 79 7031)

The effect of one blade nonperiodic setting errors on the stalling performance of compressor cascades was experimentally determined The cascade was tested over a range of values of the chordwise setting error, cascadewise setting error and angular setting error In the stalling range the nonlinear nature of the setting error effects was revealed Blade setting errors were shown to increase the outlet total pressure loss and deteriorate the outlet flow angle distribution Chordwise error had little effect on pressure distribution while cascadewise setting error had a large effect on the pressure distribution Positive angular setting error caused stall of the various blades accompanied by a large increase in the outlet total pressure loss and large variation in the outlet flow angle P T H

A79 29404 # Theoretical and experimental investigations on aerodynamically highly loaded compressor bladings with boundary layer control L Fottner (Motoren und Turbinen Union München GmbH, Munich, West Germany) In International Symposium on Air Breathing Engines, 4th, Orlando, Fla , April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 259 268 20 refs Research supported by the Bundesministerium der Verteidigung (AIAA 79 7032)

The paper develops an analytical method for the optimum design of blowing configurations for boundary layer control of highly loaded jet engine compressor blades The semiempirical method of Thomas (1961) is first used to obtain a velocity distribution around the profile The integral method of Rotta (1971) is then used for the boundary layer calculation Mixing losses are calculated on the basis of results of Thomas (1961) Cascade measurements were also made and it was shown that the velocity and not the quantity of blown air is decisive Hence the slots should be designed narrow The jet velocity required to avoid separation can be reliably calculated in advance by the method given, so that optimal blowing configuration can be designed P T H

A79-29405 # Study of the flow field behind a transonic axial compressor rotor using laser anemometry and unsteady pressure measurements R J Dunker and H G Hungenberg (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt Institut fur Luftstrahlantriebe, Cologne, West Germany) In International Symposium on Air Breathing Engines, 4th, Orlando Fla April 1 6 1979, Proceedings New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 269 276 17 refs (AIAA 79 7034)

A laser anemometer and high response pressure probes were used to study in detail the complex flow in a transonic axial compressor rotor at 20,000 rpm The investigation was aimed at providing complete data on the internal flow field at design speed for peak efficiency, near compressor surge and choke Useful data are now available on the flow vectors including the three-dimensional shock waves, the oscillating total pressures, the blade wakes and losses downstream of the rotor The experimental results presented and discussed in this paper give new impetus to transonic compressor performance improvement and to analytical flow modeling

(Author)

A79-29406 # Computer programs of flow calculation on relative stream surfaces S1 and S2 employing non orthogonal curvilinear coordinates and non orthogonal velocity components and their application to the design of turbomachine blades based on three-dimensional flow W Q Wu, R G Zhu, and C E Liu (Academia Sinica Peking Communist China) In International Symposium on Air Breathing Engines, 4th, Orlando Fla , April 1 6 1979 Proceedings New York, American Institute of Aeronautics and Astronautics, Inc , 1979, p 277 287 17 refs (AIAA 79 7035)

A79 29410 # Optimizing the endurance of a low Mach number ramjet in a cruise application H V Hattingh (Stellenbosch University Stellenbosch, Republic of South Africa) In International Symposium on Air Breathing Engines 4th Orlando, Fla April 1 6, 1979, Proceedings New York American Institute of Aeronautics and Astronautics Inc , 1979 p 319 324 6 refs (AIAA 79 7040)

A one dimensional model for calculating the flow through a ramjet operating at low supersonic Mach numbers is presented At the inlet it is assumed that the flow is critical with a normal shock at the inlet lip A linear relationship between efficiency and area ratio is assumed Complete combustion of a fuel of composition C7H14 without dissociation is assumed A lean mixture is assumed and part of the air flow is bypassed around the combustion chamber Empirical data were used for separate calculation of the pressure drag of the nose and tail sections The calculation yields the dimensions and performance characteristics of an engine for a given application, defined as a net thrust at a given flight condition P T H

A79 29411 # The effect of swirl on a ramjet dump combustor P L Buckley R R Craig, and B M Obleski (USAF, Aero Propulsion Laboratory, Wright Patterson AFB Ohio) In International Symposium on Air Breathing Engines 4th Orlando, Fla , April 1 6, 1979, Proceedings New York American Institute of Aeronautics and Astronautics Inc , 1979, p 325 335 6 refs (AIAA 79 7042)

Extensive parametric combustion tests were made with a variable angle swirler to determine its effect on the performance of a ramjet dump combustor Swirler angles were varied from 0 to 30 deg combustor length to diameter ratios from 1 5 to 3 inlet to combustor area ratios from 25 to 45 percent, and nozzle throat to combustor area ratios from 40 to 50 percent Flow into the combustor was probed in the nonburning cases to determine local flow angles as a function of swirl vane setting and also to determine when local centerline flow reversal occurred Water tunnel flow visualization studies were made to determine flow patterns at the various swirl vane settings High speed movies were taken of the combustion process in a transparent quartz chamber at different swirl vane settings Swirl has a dramatic effect on ramjet dump combustor performance and reduces the length of the combustion region by a factor of 2 in comparison with the non swirl case

(Author)

A79-29413 * # Initial wind tunnel tests at Mach 4 and 7 of a hydrogen burning, airframe-integrated scramjet R W Guy and E A Mackley (NASA Langley Research Center Hypersonic Propulsion Branch, Hampton, Va) In International Symposium on Air Breathing Engines 4th Orlando Fla April 1 6 1979, Proceedings New York American Institute of Aeronautics and Astronautics, Inc , 1979, p 347 358 17 refs (AIAA 79 7045)

A research investigation of a new fixed geometry hydrogen burning scramjet engine concept, designed for total airframe integration, is currently in progress Two heavily instrumented engine models incorporate inlet and combustor designs developed previously in component tests Initial tests of these subscale engine models are being conducted in ground facilities at conditions simulating flight at Mach numbers 4 and 7 The scramjet test results which are presented include inlet performance ignition/reaction aids, inlet combustor interactions and engine performance in terms of thrust balance measurements and internal pressure and heating rate distributions The relationship of these results to flight engine performance is discussed (Author)

A79 29414 # Transient temperature distribution in cooled turbine blades M Caprili and R Lazzeretti (Pisa, Universita Pisa Italy) In International Symposium on Air Breathing Engines 4th, Orlando Fla , April 1 6, 1979 Proceedings New York, American Institute of Aeronautics and Astronautics Inc

1979 p 361 374 Consiglio Nazionale delle Ricerche Contract No 77 01381,07 (AIAA 79 7046)

The finite element method with a new curved element is used to calculate transient two dimensional space heat conduction in cooled turbine blades Space approximation is effected with the aid of shape functions determined by the values at the vertices of an element Time approximation is made by the Crank Nicholson algorithm Numerical results for a partitioning into 55 elements are presented, and the computer code is listed P T H

A79 29416 # Turbine performance analysis and engine to rig correlation G Feo A Mannini, and F Rodi (Fiat Aviazione S p A Turin Italy) In International Symposium on Air Breathing Engines 4th Orlando Fla , April 1 6 1979 Proceedings I New York American Institute of Aeronautics and Astronautics, Inc 1979 p 383 391 (AIAA 79 7048)

Several analytical techniques for predicting turbine performance are reviewed and comparisons of their predictions with air rig test results are carried out Real engine measurements of temperature and total pressure upstream and downstream of the turbine were also made to compute turbine efficiency Engine to rig correlation gave satisfactory results in the definition of temperature and pressure profiles P T H

A79 29417 # Generation of body fitted coordinates for turbine cascades using multigrid R Camarero and M Younis (Ecole Polytechnique Montreal Canada) In International Symposium on Air Breathing Engines 4th Orlando Fla April 1 6 1979 Proceedings New York American Institute of Aeronautics and Astronautics Inc , 1979 p 393 398 (AIAA 79 7049)

To generate body fitted curvilinear coordinates for turbine cascades one must solve a system of elliptic equations to yield the physical coordinates in terms of the transformed coordinates In order to reduce computing time for this transformation the successive overrelaxation (SOR) method and the multigrid method are proposed The multigrid method is the more efficient yielding a given accuracy in roughly one half the computing time of line SOR or one third that of point SOR P T H

A79 29418 # Jet discharge coefficient through openings for parallel flow A M Rezk G W Younan (Ain Shams University Cairo, Egypt) and K Sh Kaddah (University of Technology, Baghdad Iraq) In International Symposium on Air Breathing Engines, 4th, Orlando, Fla , April 1 6 1979, Proceedings New York, American Institute of Aeronautics and Astronautics, Inc 1979 p 399 425 (AIAA 79 7050)

The effect of geometric factors and operating conditions on the discharge coefficient of tubular combustor liner wall openings was studied theoretically and experimentally on a special test rig Geometric factors studied were shape of holes or slots area ratio of holes or slots and aspect ratio Operating conditions studied were (1) incident incoming stream velocities up to 48 m/sec (2) static pressure ratio across the plate up to 1 14, and (3) bleed ratio up to unity Good agreement between theory and experiment is obtained by introducing a discharge shape factor P T H

A79 29419 # Blade to blade pressure, temperature, and velocity profiles downstream of a single rotor row at high subsonic speed P Kool (Brussel, Vrije Universiteit Nationaal Fonds voor Wetenschappelijk Onderzoek Brussels Belgium) and Ch Hirsch (Brussel, Vrije Universiteit, Brussels, Belgium) In International Symposium on Air Breathing Engines, 4th Orlando Fla , April 1 6 1979, Proceedings New York American Institute of Aeronautics and Astronautics Inc 1979 p 427 432 12 refs (AIAA 79 7033)

A hot wire probe operated at two different overheat ratios is used to measure total temperature downstream of an axial compressor rotor Three velocity components are obtained along with the total temperature The use of a pressure probe yields complementary information on the blade to blade flow Through the knowledge of the velocity field one determines the blade to blade static pressure evolution It is shown that the radial gradient of the radial stress is an important parameter appearing in the pitchwise averaged radial momentum equation P T H

A79 29477 # Interactive microprogrammable control display unit /IMP CDU/ In Advanced Aircrew Display Symposium, 4th Patuxent River Md , May 10 1978 Proceedings Patuxent River Md U S Navy, Naval Air Test Center, 1978 p 3 16

Details of light emitting diode technology are considered taking into account gallium semiconducting materials, the electrical characteristics of LEDs and the approaches used for obtaining the various colors The LED state of the art is discussed along with LED module design parameters LED drive circuits aspects of LED module description and LED display module characteristics A description of IMP CDU is also provided and the airborne applications of IMP CDU are examined It is concluded that the development of the IMP CDU opens the door to effective communication between the pilots and complex aircraft systems The IMP's small size and high reliability make it ideal for use in the aircraft cockpit G R

A79 29478 # V/STOL all weather HUD landing simulation /Status report/ A E Kelvin (Grumman Aerospace Corp Bethpage, N Y) In Advanced Aircrew Display Symposium 4th Patuxent River Md May 10 1978 Proceedings Patuxent River, Md U S Navy Naval Air Test Center, 1978 p 17-40

The considered study is concerned with the problem of landing a V/STOL aircraft on a nonaviation ship (i e Destroyer Escort) The problem is further magnified when one considers the introduction of all weather landing requirements in high sea states An investigation is conducted regarding the problem of landing a V/STOL aircraft on a Destroyer Escort (DE) in all weather environment using a HUD Data was collected from four pilots as to their accuracy of landing on the deck of the DE as well as the time to touchdown during the sea state 5 condition G R

A79 29479 # Design benefits from V/STOL control/display simulation program at Lockheed T L Kienholz and R B Collender In Advanced Aircrew Display Symposium 4th Patuxent River Md , May 10 1978 Proceedings Patuxent River, Md , U S Navy, Naval Air Test Center 1978 p 41 63 8 refs

A description is presented of a V/STOL flight simulation program The primary purpose of the program is to provide meaningful data related to the interaction of aircraft control system and pilot display characteristics on pilot rating and performance during the conduct of representative VTOL terminal area operations under instrument conditions Lessons learned from past simulator programs are examined taking into account visual systems manned simulation support, and details regarding the simulation facility Attention is also given to expected simulator results and display considerations G R

A79 29480 # Future VSTOL requirements for omnidirectional low range airspeed D L Green (Pacer Systems Inc Arlington, Va) In Advanced Aircrew Display Symposium 4th Patuxent River Md , May 10 1978 Proceedings Patuxent River Md U S Navy Naval Air Test Center 1978, p 64 75

Advanced VSTOL aircraft have a number of potential requirements for omnidirectional low range airspeed data This paper focuses on two interrelated subsystem applications pilot displays and flight control system augmentation Ideas related to display formats are reviewed in light of the companion need for flight control augmentation The paper suggests that there is a valid display requirement which when properly implemented can be expected to somewhat reduce the criticality of control system augmentation design while significantly expanding the scope of useable flight path control techniques and enhancing operational flight safety (Author)

A79-29482 # Head up Display and Weapon Aiming Computer /HUDWAC/ system for the Sea Harrier A Cameron (Smiths Industries, Ltd Cheltenham Glos England) In Advanced Aircrew Display Symposium, 4th, Patuxent River, Md May 10, 1978, Proceedings Patuxent River Md , U S Navy, Naval Air Test Center 1978 p 103 112

An outline is provided of the HUDWAC functions and hardware developed to meet the Sea Harrier s operational requirements, among which is the PIA mode Attention is given to the Sea Harrier HUDWAC hardware the mode repertoire the air/ground bomb delivery mode, the air/air guns display, radar symbology, the Sea Harrier block schematic, the electronic unit aspects of maintenance and a test print out sample G R

A79 29483 Sea Harrier night and low visibility approach development R H Burn (Ministry of Defence /Procurement Executive/ London England) In Advanced Aircrew Display Symposium 4th Patuxent River Md May 10 1978 Proceedings Patuxent River Md U S Navy, Naval Air Test Center 1978 p 113 132, 134 140

The first flight of the Sea Harrier will occur in the summer of this year with deliveries of the 24 aircraft so far ordered for the British Navy starting a year later The go ahead signal was given in 1975 against a background of defense budget cuts which resulted in very tight funding and a philosophy of minimum change in design from the Air Force s ground attack Harrier although it was accepted that because the Navy's primary requirement was for an air defense aircraft there would have to be a new weapon system Operation at sea in all weathers further dictated the need for development of the instrument approach capability but only on a minimum change minimum cost basis Fourteen night sorties were included in the flight test phase G R

A79 29484 # An X 22A flight experiment to investigate control-display requirements for the AV 8B VTOL aircraft J V Lebacqz R C Radford and R E Smith (Calspan Corp , Flight Sciences Dept Buffalo N Y) In Advanced Aircrew Display Symposium 4th, Patuxent River, Md May 10 1978 Proceedings Patuxent River Md U S Navy Naval Air Test Center 1978, p 142 172 17 refs Contract No N62269 76 C 0370

This paper presents a description of a flight test program conducted using the U S Navy X 22A variable stability, variable display V/STOL aircraft A simulation of the McDonnell Douglas AV 8B Advanced Harrier for prescribed terminal area approach profiles was implemented with the X 22A and then a variety of stability/control augmentation designs and head up display (HUD) presentation concepts were evaluated for decelerating terminal area operations under simulated instrument meteorological conditions The VTOL terminal area problem is reviewed and reasons for the experiment designs are outlined followed by summaries of the control systems and display presentations that were examined and by a description of the AV 8B simulation with the X 22A The pilot rating data obtained are then presented and described on a preliminary basis Questions raised by the data and tentative results that they indicate, are discussed (Author)

A79 29485 # Digital Avionics Information System /DAIS/ and Advanced Integrated Display System /AIDS/ cockpit programs L Hitchcock (U S Naval Material Command, Naval Air Development Center Warminster Pa) and J Reising (USAF, Flight Dynamics Laboratory Wright Patterson AFB Ohio) In Advanced Aircrew Display Symposium 4th Patuxent River Md , May 10 1978, Proceedings Patuxent River, Md U S Navy, Naval Air Test Center 1978 p 173 180

Over the past four years there have been a number of cooperative efforts between the AIDS and DAIS programs in the area of cockpit design There are current cooperative efforts and there are also future efforts planned specifically in the area of flight symbology and the use of color in complex situation displays These two programs can serve as a model for cooperative efforts among advanced development programs between the two Services The cooperation has been highly successful and both Services have benefited immensely from the joint efforts (Author)

A79 29486 # Displays for Army combat aviation M Foster Jr (U S Army Human Engineering Laboratory Aberdeen Proving Ground Md) In Advanced Aircrew Display Symposium, 4th, Patuxent River Md , May 10, 1978 Proceedings Patuxent River Md U S Navy Naval Air Test Center 1978 p 181 250

A brief description is provided of the more demanding aspects of the employment of Army combat aviation specifically the attack helicopter Attention is also given to the display media currently programmed for existing and future attack helicopters, the possible impact of state of the art technology on these media and the Army's approach to solve the problem focused on electrooptical displays G R

A79 29574 # Northrop F 5 Case study in aircraft design W G Stuart (Northrop Corp , Aircraft Group Hawthorne Calif) New York American Institute of Aeronautics and Astronautics Inc 1978 219 p

An outline is presented of the development of the T 38/F 5 family of fighter/trainer aircraft from 1956 through the present The F 5E Tiger II is the latest model of this line For the F 5, this evolution started in 1956 with the N 156 project and is continuing at the present time with development of advanced models of the F 5 The F 5 gradually evolved over the years in response to the needs of the customer The first member of the T 38/F 5 family to fly was the Mach 1 25 T 38 which became the standard supersonic jet trainer of the USAF and was also used by the German Air Force for pilot training in the U S It is pointed out that the F 5 development is typical of the steps involved in the design of a supersonic jet fighter G R

A79 29590 Propulsion research Current status and future prospects (Antriebsforschung - Bilanz und Perspektiven) G Winterfeld (Deutsche Forschungs und Versuchsanstalt für Luft- und Raumfahrt, Institut fur Antriebstechnik Cologne West Germany) *DFVLR Nachrichten* Feb 1979 p 13 19 In German

Improvements in the area of propulsion techniques are discussed in the light of current and expected research, particularly at the DFVLR s Propulsion Engineering Institute Examples of development work are presented including a design for turbomachine blading The basic areas relating to future research are mentioned A A

A79 29591 Current work in materials and methods-of-construction research (Aktuelle Arbeiten in der Werkstoff- und Bauweisenforschung) C J Winter (Deutsche Forschungs und Versuchsanstalt für Luft und Raumfahrt Bereich Wissenschaftlich Technische Betriebseinrichtungen, Stuttgart West Germany) *DFVLR Nachrichten,* Feb 1979, p 20-24 In German

Developments in a number of research institutes in West Germany are examined taking into account the Institute for Structural Mechanics in Brunswick the Institute for Aeroelastics in Gottingen, the Institute for Space Simulation in Cologne Porz, the Institute for Methods of Construction and Design Research in Stuttgart Attention is given to German constributions to investigations to be conducted in Spacelab, a national composite program, the use of a nondestructive testing method based on holograms, the replacement of titanium structures by composites the effect of a reduction of the weight of the aircraft structure, and a turbine rotor made of ceramic materials G R

A79 29592 Case study in aircraft design The Boeing 727 New York, American Institute of Aeronautics and Astronautics Inc , 1978 78 p

The Boeing 727 aircraft is discussed The total design program is considered including engine configuration manufacturing costs and derivative models Aerodynamic and design developments of the 727 100 model are taken into account, as are the flight tests and the

results The 727 200 model is described together with a review of future development projects A A

A79 29593 Requirements and major decision outline Total program J E Steiner In Case study in aircraft design The Boeing 727 New York American Institute of Aeronautics and Astronautics Inc , 1978, p 1 8

The three engine 727 aircraft was designed around the low by pass ratio fan concept giving it a distinct noise advantage over the pure jet The design program of the airplane is discussed, including landing gear, wing horizontal tail, and fuselage cross section structural concepts Engine placement is considered noting that after extensive research an aft engine configuration was selected Also considered are the development of flight controls and of a new rain removal system for which a special tunnel was constructed Mechani cal dispatch reliability is taken into account emphasizing the use of the empirical method Manufacturing costs are noted as are various derivative models A A

A79 29594 Aerodynamic development of the 727-100 G M Bowes In Case study in aircraft design The Boeing 727 New York, American Institute of Aeronautics and Astronautics Inc 1978 p 9 22 8 refs

The aerodynamics tests program of 727 100 is discussed Per formance studies are taken into account noting that the data for cruise drag estimates was based on wind tunnel increments applied to flight test levels obtained on previous aircraft The high lift system, including flap geometry as well as transition flap is considered, as is the cruise configuration development The flight test results are reviewed, indicating that the engine installation losses due to bleed air for supporting auxiliary power turned out to be less than had been estimated A A

A79 29595 Design development of the 727 100 F A Maxam In Case study in aircraft design The Boeing 727 New York, American Institute of Aeronautics and Astronautics, Inc , 1978, p 23 54

Design development of the 727 100 aircraft is discussed in the context of objectives and requirements Structural components are considered, including the vertical fin the horizontal stabilizer, the leading edge slats and flap system, and the landing gear Propulsion system is taken into account with attention given to engine inlet, starting mechanism, thrust reverser auxiliary power unit fuel dump ing defueling etc The flight controls system is described noting that integration of flight controls and automatic pilot is made by applying the autopilot signals directly to the same power control units used in pilot controlled flight Also described is the flight deck including captain and first officer's main panel, and control pedestal The electrical/electronics equipment is examined as is the aircondi tioning system including pressurization control, and ice protection equipment Interior arrangement, airstair cargo compartments, as well as water and oxygen systems are considered A A

A79 29596 Flight test results S L Wallick In Case study in aircraft design The Boeing 727 New York American Institute of Aeronautics and Astronautics, Inc , 1978 p 55 59

Flight test results for the 727 aircraft including the wing high lift configuration, the fully powered flight controls, and the aft fuselage mounted engines are considered Airworthiness, perfor mance verification and FAA certification are taken into account, as are flight test data system requirements and composition Follow on testing is noted A A

A79 29597 The 727 200 development M C Gregoire In Case study in aircraft design The Boeing 727 New York American Institute of Aeronautics and Astronautics Inc 1978 p 61 69

The design of the 727 200 aircraft a modified version of the 727 100 is discussed The wing is considered noting that no perfor mance improvements were made although changes in flap angle and gap scheduling were considered The center engine inlet is taken into account, indicating that it has been changed from an oval to a circle with the inlet duct reshaped down through the first turn so that it handles 4% more airflow with less diffusion Changes in cruise drag balance and cargo compartment are noted as are development costs The advanced 727 200 is mentioned, together with a review of performance improvements A A

A79 29606 Concorde in service W J Strang and R M McKinlay (British Aerospace, Aircraft Group Weybridge Surrey England) *Aeronautical Journal* vol 83, Feb 1979 p 39 52

The Concorde aircraft is discussed Configuration parameters are considered, noting that altitude range is 0 60,000 ft, with air speed and Mach number at 0 530 kts and 0 2 04 respectively Performance is taken into account as is engineering reliability including systems and powerplant The environmental impact is examined, emphasizing noise and boom problems It is concluded that the aerodynamic performance of the aircraft has met expectations while the overall reliability is in need of improvement A A

A79-29607 The future shape of medium and long range civil engines P H Young (Rolls Royce Ltd London, England) *Aeronautical Journal*, vol 83 Feb 1979 p 53 61

The future shape of medium and long range civil aircraft is discussed in the context of the impact of the forecast fuel price on airline finance Propulsive and thermodynamic machinery is con sidered noting that the next generation of medium to large turbofans should not increase their compressor temperature rise beyond the present 500 C Future thermodynamic parameters, such as pressure ratio and heat exchangers, are taken into account, emphasizing the vulnerability of their prediction Tasks for the future are reviewed including weight engine and parts costs, fuel quality and launching costs A A

A79-29659 Shock waves around bodies travelling at slight ly greater than sonic speed A Rizzi (Flygtekniska Forsoksanstalten, Bromma Sweden) In Recent developments in theoretical and experimental fluid mechanics Compressible and incompressible flows. Berlin Springer Verlag 1979 p 67 75 7 refs

Zierep's approximate analytical method for predicting position and shape of the bow shock wave produced in supersonic inviscid flow is reviewed Predictions based on this method are compared with numerical solutions of the complete gasdynamic equations for a cone cylinder and a sphere The accuracy of the method for both slender and blunt bodies is shown P T H

A79 29660 Density distribution in a non stationary bow wave in a transonic flow G Patz In Recent developments in theoretical and experimental fluid mechanics Compressible and incompressible flows. Berlin Springer-Verlag, 1979, p 76 84 11 refs

The density distribution in an unsteady shock ahead of a blunt body in transonic flow was measured with a laser differential interferometer The results were compared with those obtained from the velocity distribution of Muller and Matschat (1964) with the assumption of frozen flow For both a sphere and a cylinder, the density remains practically constant after the arrival of the reflected shock, and the shock leaves behind it the steady Muller Matschat solution P T H

A79 29676 Transonic flow computations by finite elements - Airfoil optimization and analysis A Eberle (Messerschmitt Bolkow Blohm GbmH Munich, West Germany) In Recent develop ments in theoretical and experimental fluid mechanics Compressible and incompressible flows. Berlin Springer-Verlag, 1979, p 249-256

The paper describes an optimization procedure intended to alter the contour of a given arbitrary airfoil at desired supercritical design

conditions in such a way that the resulting flow is shock free This is achieved by an elliptical continuation of the flow into the supersonic zone Such an approach causes the flow to be continuous The solution obeys the physical equations only in the subsonic flow regime but not in the supersonic Therefore the supersonic flow field has to be corrected by a hyperbolic method in a straight forward manner using the flow quantities along the sonic line as initial values As a result, a new supersonic airfoil contour with shock-free flow is obtained The incorporation of a suitable artificial viscosity into the definition of the density allows the conversion of the procedure to an analytical method S D

A79 29684 Gortler vortices in the nonlinear region Y Aihara (Tokyo University, Tokyo Japan) In Recent developments in theoretical and experimental fluid mechanics Compressible and incompressible flows Berlin, Springer Verlag, 1979, p 331 338

The paper is concerned with a quantitative evaluation of the relation between the nonlinear development and the onset of unsteadiness of logitudinal vortices in a low speed wind tunnel of the blowdown type The rectangular curved wall channel made of transparent acrylic resin has a concave wall with 1 m radius of curvature The channel is attached to the wind tunnel exit with a 5-mm gap so as to make the boundary layer develop from the leading edge of the wall A flap is installed at the convex side of the channel exit to avoid possible boundary layer separation at the leading edge Experiments with and without artificial disturbances are considered Findings for the artificially excited motion of Gortler vortices are given It is concluded that the nonlinear development of Görtler vortices affects the transition of the boundary layer through the global unsteadiness of the system as well as the local formation of unstable mean velocity profiles S D

A79 29694 Considerations regarding velocity distribution and wall friction in incompressible axisymmetric turbulent boundary layers with transverse curvature (Einige Uberlegungen zur Geschwindigkeitsverteilung und zur Wandreibung in inkompressiblen rotationssymmetrischen turbulenten Grenzschichten mit Querkrümmung) H H Fernholz and T Podtschaske (Berlin, Technische Universitat Berlin West Germany) In Recent developments in theoretical and experimental fluid mechanics Compressible and incompressible flows Berlin, Springer-Verlag 1979 p 427 437 13 refs In German

Boundary layers for axisymmetric configurations are important in aeronautics in the area of machine construction and in industrial processing engineering A significant effect of the lateral curvature on the boundary layer can be noticeable in the case of an aircraft fuselage and a long fiber The basic mathematical relations regarding the curvature effects are considered, taking into account the momentum theorem of boundary layer theory and the possibility to obtain information regarding the friction coefficient on the basis of an extrapolation of the results obtained with laminar boundary layers G R

A79-29701 The wing section theory of Kutta and Zhukovski I Ilani (National Aerospace Laboratory Tokyo, Japan) In Recent developments in theoretical and experimental fluid mechanics Compressible and incompressible flows Berlin Springer Verlag 1979 p 511 516 21 refs

The present paper reviews the development of fluid dynamics in the twentieth century, starting with Prandtl s boundary layer theory and the wing section theory formulated independently by Kutta (1902 1911) and Joukowski (1906 1916) A survey of literature on the wing section theory in its insipient stage is presented V P

A79-29702 The inverse problem for multiconnected airfoil systems W J Prosnak (Instytut Techniki Lotniczej i Mechaniki Stosowanej Warsaw Poland) In Recent developments in theoretical and experimental fluid mechanics Compressible and incompressible flows Berlin, Springer Verlag, 1979 p 517 528 9 refs

The considerations in the present paper are concerned with the two dimensional inviscid incompressible flow about a finite systems of airfoil sections An attempt is made to develop a theory for solving the inverse problem (to determine the system of airfoils from some given elements of the flow field) It is shown that the theory can be used not only to formulate the inverse problem but also mixed problems where the geometry of some of the airfoils and their locations are given and the remaining airfoils have to be designed V P

A79 29705 Small disturbance swirl flow in turbomachinery bladings F G Sator (Lausanne Ecole Polytechnique Federale, Lausanne Switzerland) In Recent developments in theoretical and experimental fluid mechanics Compressible and incompressible flows Berlin Springer Verlag, 1979, p 557 567 6 refs

The present analysis deals with rotating flow fields between blade rows, where the swirl velocity is of the same order of magnitude as the axial velocity It is shown that shear disturbances associated with a weak pressure field are not convected in strong rotational flows if their amplitudes are small they propagate slowly and may have oscillatory behavior in the period of the rotational period of the base flow with an interchange between the radial and tangential velocity components In flows with solid body and free vortex components shear disturbances can be oscillatory or unstable V P

A79 29734 Electronic maps for tomorrow s cockpits M Shohat *Military Electronics/Countermeasures* vol 5, Mar 1979, p 58, 60, 61

The newly developed Electronic Terrain Mapping (ETM) system to be used in future cockpits for such tasks as terrain navigation and avoidance weapon delivery sensor correlation and IFR backup during terminal phases of flight is discussed The features distinguishing the ETM from existing avionic systems are considered noting that the first can provide the pilot with a real time computer generated scene appearing similar to the actual scene The Digital Data Base (DDB) comprising the source data for the electronic map, is described indicating that it represents an ongoing large scale effort by the Defense Mapping Agency to produce a global digital library of terrain and planimetry/hydrography at several levels of resolution The objectives of the ETM lab are taken into account emphasizing the goal of developing a system compatible with the representative access rates obtained with a bubble memory Parallel work in industry is considered, as is the AFAL s projected acquisition of a brassboard model A A

A79 29759 # Operational and regulatory questions related to inertial systems (Questions operationnelles et reglementaires liees aux systèmes inertiels) D Mottard (Direction Génerale de l Aviation Civile Service de la Formation Aeronautique et du Controle Technique Paris France) *Société des Electriciens, des Electroniciens et des Radioelectriciens Journée d'Etudes sur la Navigation par Inertie, Ecole Superieure d'Electricité Gif sur-Yvette, Essonne France Nov 15 1978, Paper* 15 p In French

The author briefly reviews the steps he would have to take in order to learn the operational requirements and regulations concerning the use of an inertial guidance system for aircraft of his airline flying the North Atlantic routes A brief discussion of the ARINC norms on inertial navigation is given P T H

A79 29760 # Technological evolution of inertial navigation for aircraft (Evolutions techniques de la navigation par inertie pour avion) L Camberlein (Societe d Applications Generales d'Electricite et de Mecanique, Paris, France) *Societe des Electriciens, des Electroniciens et des Radioelectriciens, Journee d'Etudes sur la*

Navigation par Inertie, Ecole Superieure d Electricite, Gif sur-Yvette, Essonne, France Nov 15, 1978 Paper 36 p In French

Progress in inertial navigation systems for aircraft in the last ten years is outlined Examples of reductions in volume and weight and of improvements in performance are given New possibilities for classical gimballed systems are discussed It is shown how progress in digital technology has made it possible to integrate new functions with a view to global optimization of cost and effectiveness P T H

A79 29762 # **Inertial navigation A historical account with a description of a modern system (Navigation par inertie - Historique et description d un systeme moderne)** P Lloret (Societe d'Applications Generales d'Electricite et de Mecanique, Paris, France) *Societe des Electriciens, des Electroniciens et des Radioelectriciens, Journee d'Etudes sur la Navigation par Inertie, Ecole Superieure d'Electricite, Gif sur Yvette Essonne, France, Nov 15 1978 Paper* 13 p In French

The paper retraces the steps in the development of inertial navigation emphasizing in particular the developments in the United States and in France A brief description of the ULISS 52 of SAGEM is included, which represents the technology that will be in service on military aircraft of the next decade P T H

A79 29772 # **Fundamental problems and methods for improving systems for planning the development of civil aviation (Osnovni zadachi i metodi udoskonalennia sistemi planuvannia rozvitku tsivil'noi aviatsii)** V S Mikhalevich, R V Sakach G M Iun and E F Kosichenko *Akademiia Nauk Ukrains koi RSR, Visnik*, vol 42 Dec 1978 p 45-49 In Ukrainian

A79-29801 **Numerical methods in laminar and turbulent flow, Proceedings of the First International Conference, University College of Swansea, Swansea, Wales, July 17-21 1978** Edited by C Taylor K Morgan (Swansea, University College, Swansea, Wales), and C A Brebbia (Southampton, University Southampton, England) London Pentech Press, 1978 1018 p

Numerical methods are developed for problems in viscous flow turbulent flow, boundary layer analysis flow with heat transfer, free surface flows and lubrication, turbomachinery and airfoil flow, two phase flow and meteorological flows, and mass transport and convection Individual topics studied include parabolized Navier Stokes solutions for hypersonic viscous flows over blunt cones at large angles of attack, numerically mapped macroelements for multiply connected flow fields, turbulence length scales in non equilibrium flows, solution of the Falkner Skan equation by quasi linearization explicit finite element solution to transient convective conductive heat transfer problems, and a finite element for a mild singularity in lubrication P T H

A79 29804 **H/ 1/ least squares method for the Navier Stokes equations** R Glowinski (Paris VI Universite Paris France) B Mantel J Periaux (Avions Marcel Dassault Breguet Aviations Saint Cloud, Hauts de Seine France), and O Pironneau (Institut de Recherche d'Informatique et d'Automatique Le Chesnay Yvelines France) In Numerical methods in laminar and turbulent flow, Proceedings of the First International Conference Swansea, Wales July 17 21 1978 London Pentech Press 1978 p 29 42 8 refs Direction des Recherches et Etudes Techniques Contract No 77/140

A mixed finite element discretization scheme for the unsteady Navier Stokes equation is presented To discretize the time derivative a fully implicit two step scheme (unconditionally stable) is developed by a Sobolev space H(-1) least squares method The Stokes problems are decomposed into scalar approximate Dirichlet problems The validity of a code based on this method was checked in simulations of Couette flow and unsteady two dimensional flow past a cylinder at low Reynolds number P T H

A79-29806 **Parabolized Navier Stokes solutions for hypersonic viscous flows over blunt cones at large angles of attack** J D Waskiewicz and C H Lewis (Virginia Polytechnic Institute and State University Blacksburg, Va) In Numerical methods in laminar and turbulent flow Proceedings of the First International Conference Swansea Wales July 17 21 1978 London Pentech Press, 1978 p 55 67 8 refs

Hypersonic viscous flowfield solutions have been obtained using a parabolized Navier Stokes (PNS) method for sphere cones at angles of attack up to 38 deg A viscous shock layer code (VSL2D) was used to provide the necessary blunt body solutions Experimental data at Mach 18 on a 10 deg half angle spherically blunted cone model were used to test the predictions Experimental data included heat transfer and wall pressure distributions at a freestream Reynolds number of 15 000 per foot and incidence angle of 10 deg Studies were also conducted on a 7 deg half angle spherically blunted cone at 23 and 38 deg incidence angle at freestream Mach numbers 22 8 and 25 8 at altitudes of 180 and 240 thousand feet to investigate the effects of Mach number Reynolds number angle of attack and computational procedure Both explicit and implicit models of the axial pressure gradient were studied for application under various flowfield conditions Applicability of the PNS technique for wind tunnel and free flight conditions is discussed (Author)

A79 29840 **The finite element method for turbomachinery analysis** W G Habashi (Concordia University Montreal, Canada) and E G Dueck (Pratt and Whitney Aircraft of Canada, Ltd , Montreal, Canada) In Numerical methods in laminar and turbulent flow Proceedings of the First International Conference, Swansea Wales July 17 21, 1978 London Pentech Press 1978 p 689 695 7 refs

The present paper deals with the application of the finite element method to incompressible and compressible potential flows in the context of turbomachinery Recently proposed approaches to the incompressible and compressible blade-to blade problems are reviewed and a solution is obtained which simplifies the existing techniques and also improves their accuracy V P

A79 29859 **Acoustic simulation of the flight vibration environment** D Sims *Society of Environmental Engineers Journal* vol 18 1 Mar 1979 p 27 29 Research sponsored by the Ministry of Defence (Procurement Executive)

Acoustic simulation of the flight vibration environment is discussed with emphasis on the components of the progressive wave tube providing the most efficient use of the available acoustic energy The noise generator is considered, noting that the siren currently in use comprises four rotors arranged to chop the air flowing from a plenum chamber and exhausting through a suitable horn The test section is taken into account indicating that the main requirements of the section are to contain the pressure fluctuations evenly around the test specimen with minimum loss through the walls, and to minimize the occurrence of standing waves Acoustic termination is described, showing that reflection of acoustic energy from the termination of the progressive wave tube is prevented by providing an acoustically absorbent surface to the incident sound waves The horns system designed to couple the siren to the progressive wave tube and the tube to the termination is examined as is development work on the progressive wave tube system A A

A79 29899 * # **Operation and evaluation of the terminal configured vehicle mission simulator in an automated terminal area metering and spacing ATC environment** J A Houck (NASA Langley Research Center, Hampton Va) *Summer Computer Simulation Conference Toronto Canada July 16-18 1979 Paper* 8 p 9 refs

The development of a mission simulator for use in the Terminal Configured Vehicle (TCV) program is outlined The broad objectives of the TCV program are to evaluate new concepts in airborne systems and in operational flight procedures These evaluations are directed toward improving terminal area capacity and efficiency,

improving approach and landing capability in adverse weather and reducing noise impact in the terminal area A description is given of the design features and operating principles of the two major components of the TCV Mission Simulator the TCV Aft Flight Deck Simulation and the Terminal Area Air Traffic Model Simulation, and their merger to form the TCV Mission Simulator The first research study conducted in the Mission Simulator is presented along with some preliminary results S D

A79 29900 * # Verification and validation of the NASA Terminal Configured Vehicle's /TCV/ Wind Analysis program using real time digital simulation J E Dieudonne (NASA, Langley Research Center, Hampton Va) *Summer Computer Simulation Conference, Toronto, Canada July 16 18, 1979 Paper* 8 p

NASA s Terminal Configured Vehicle (TCV) program has been established to develop and evaluate aircraft and flight management technology that will benefit conventional takeoff and landing operations in the terminal area To this end a process whereby estimates of longitudinal lateral and vertical winds are obtained using the present complement of sensors onboard the TCV aircraft (B737 100) is developed The results of the simulation experiment to verify and validate the TCV B737 Data Merging and Wind Analysis program have shown that the wind analysis algorithms are correct and that very satisfactory estimates of all three wind components are obtained even in the presence of adverse atmospheric conditions and realistic measurement noise In realistic worst case conditions, wind component errors of the order of + or 2 0 knots longitudinally + or 0 5 knot laterally and + or 1 0 knot vertically are to be expected S D

A79-29935 # Access, fares frequency Effects on airport traffic. R de Neufville (MIT Cambridge Mass) and C R King (Port of Oakland, Oakland Calif) *ASCE, Transportation Engineering Journal,* vol 105 Mar 1979, p 109 125 30 refs Research supported by the University of California

In an effort to improve the understanding of the variations of the loads on airports and thus to make it possible to design airports more appropriately, an investigation was conducted regarding the effects of airport access, and of airline fares and frequency on airport traffic Specifically, a case study of the Texas intrastate air markets was carried out in which closely spaced changes in each of these factors provided a situation as close to a controlled experiment as one is likely to find in transportation G R

A79 29972 # Determination of the suitability of soils for the construction of dirt runways (Okreslanie przydatnosci gruntow do projektowania lotniskowych nawierzchni gruntowych) F Kazmierczyk and B Tymkiewicz (Instytut Techniczny Wojsk Lotniczych Warsaw Poland) *Technika Lotnicza i Astronautyczna,* vol 34 Feb 1979 p 22 23 In Polish

A79 29973 # Information systems in civil aviation (Informatyka w lotnictwie cywilnym) A Gruszecki (Centralny Zarzad Lotnictwa Cywilnego Poland) *Technika Lotnicza i Astronautyczna,* vol 34, Feb 1979, p 24 28 In Polish

The paper deals with organizational and functional aspects of a commercial aviation computerized system (and its backup facilities) currently being considered for installation in Poland to meet the aviation requirements over the period ending in 1985 A structural diagram of the computerized system is discussed V P

A79 30011 Environmental synergism and simulation in resin matrix composites L McKague (General Dynamics Corp Fort Worth, Tex) In Advanced composite materials - Environmental effects Proceedings of the Symposium Dayton Ohio, September 29, 30, 1977 Philadelphia, Pa American Society for Testing and Materials 1978 p 193 204 13 refs Research sponsored by the General Dynamics Corp

Recent investigations have shown that absorbed moisture lowers glass transition of epoxy resin more than indicated by currently accepted models The resulting glass transition value limits supersonic service conditions This limitation results because exceeding glass transition causes the 'thermal spike effect' and greatly reduces the strength of graphite epoxy These circumstances are reviewed and used to show the importance of realistically simulating airfield humidity and flight temperatures during testing A new economical approach is described for simulating realistic humidities for large structures (Author)

A79 30012 Moisture-altered viscoelastic response of graphite/epoxy composites F W Crossman, R E Mauri, and W J Warren (Lockheed Research Laboratories, Palo Alto, Calif) In Advanced composite materials Environmental effects Proceedings of the Symposium, Dayton, Ohio, September 29, 30, 1977 Philadelphia, Pa , American Society for Testing and Materials, 1978, p 205 220 15 refs Research supported by the Lockheed Missiles and Space Independent Research Program

Results of experiments to evaluate the degree of moisture induced swelling and plasticization in T300/934, T300/5209 GY70/339 composites are described Swelling was found to be a nonlinear reversible function of equilibrium moisture content Out-of plane swelling was several times larger than in plane transverse swelling in the unidirectional composites Equilibrium moisture content was found to vary with exposure temperature as well as humidity in the 339 and 5209 matrix systems The in plane shear properties were determined as a function of time temperature, and equilibrium moisture content and master curves of temperature and moisture compensated modulus versus time were constructed for each material Nonsymmetric cross plied laminates were employed to study the alteration of residual stresses in T300/5209 and GY70/339 as a function of temperature and moisture content The level of residual stresses measured for a given equilibrium moisture content was found to be a function of the temperature at which the moisture was absorbed (Author)

A79 30155 Surface current injection techniques - A theoretical investigation K S Kunz, B W Torres, R A Perala, J M Hamm, M L Van Blaricum and J F Prewitt (Mission Research Corp Albuquerque N Mex) *(IEEE, DNA, NASA, and DOE, Annual Conference on Nuclear and Space Radiation Effects 15th, Albuquerque N Mex July 18-21, 1978) IEEE Transactions on Nuclear Science,* vol NS 25, Dec 1978 p 1422 1427 7 refs Contract No N60921 77 C 0117

A theoretical study was undertaken to see whether significant improvements were possible in surface current injection techniques (SCIT) for simulating EMP induced aircraft responses Its specific objectives were to determine the feasibility of quality simulation with SCIT, to identify promising configurations and to specify practical requirements for implementation Past attempts at directly injecting currents on aircraft surfaces have met with limited success However SCIT remains attractive because of low cost and portability The theoretical approach employed the three dimensional, finite difference code THREDE reported by Holland (1976) It was faster and cheaper than experimentation The investigation shows that the SCIT approach to EMP aircraft simulation using the proper configuration can provide a quality simulation while maintaining portability and low cost G R

A79 30174 # Design of a typical aeronautical structure from carbon resin composites (Progettazione di una tipica struttura aeronautica in carboresina) P Cerreta G De Mita, S Mignosi, V Renta, and N Sarcinelli (Aeritalia S p A Naples, Italy) *(ASMECCANICA and Associazione Meridionale di Meccanica Convegno Nazionale sui Materiali Compositi, 3rd Milan, Italy, May 11 13 1978) Meccanica Italiana* vol 14 May 1978, p 55 62 8 refs In Italian

The design of a spoiler fabricated from carbon fiber reinforced plastic is discussed Three design possibilities for the spoiler are under investigation a version based on metal spoiler design and using metal supports a design eliminating the usual longeron and metallic connecting elements, and a version manufactured by a technique

which permits simultaneous polymerization of all the carbon fiber reinforced plastic elements Particular attention is given to the static thermal and fatigue properties of the laminates J M B

A79 30281 Determination of the flaw size in turbine rotors by ultrasonics - A necessary requirement for fracture-mechanics test evaluation (Fehlergrössenbestimmung an Turbinenläufern mit Ultraschall Eine notwendige Voraussetzung fur bruchmechanische Aussagen) H J Meyer W Prestel, D Heinrich (Maschinenfabrik Augsburg Nurnberg AT, Nurnberg West Germany) In Recent developments and special methods of NDT, European Conference on Non Destructive Testing 1st Mainz, West Germany, April 24-26 1978 Proceedings Volume 1
Berlin Deutsche Gesellschaft fur Zerstörungsfreie Prüfung, 1978, p. 73-82 In German

A comparison of the reflectivity and echo dynamics methods shows that the echo dynamics evaluation provides better values even in cases in which an oblique defect location and surface roughness produce greater effects The described procedure was found to provide a useful analysis method It is suitable for manual and mechanical tests with electronic data processing evaluation G R

A79 30323 Possibilities concerning the nondestructive testing of composite materials with the aid of holography (Moglichkeiten der ZfP von Verbundwerkstoffen mit Hilfe der Holographie) R Schutze (Deutsche Forschungs- und Versuchsanstalt fur Luft und Raumfahrt, Institut fur Strukturmechanik Braunschweig, West Germany) In Recent developments and special methods of NDT, European Conference on Non-Destructive Testing, 1st, Mainz West Germany April 24-26, 1978 Proceedings Volume 3
Berlin Deutsche Gesellschaft fur Zerstörungsfreie Prüfung, 1978, p 681 688 In German

The problem of quality control and assurance in the case of fiber reinforced materials has become very important in connection with the increasing employment of fiber reinforced plastics for supporting structures in the areas of light construction and aircraft design It has been found that holographic interferometry is particularly suited for the nondestructive testing of components made of composite materials An application of this method makes it possible to recognize in components made of fiber reinforced materials clearly all weak and defective locations which have an effect on surface displacements The testing procedure used can be based on double-exposure or real time holography G R

A79 30376 Researches on air cooled high temperature turbine Chofu Japan National Aerospace Laboratory 1978 665 p In Japanese and English

The papers report on experimental and analytical studies of methods of achieving efficient blade cooling in high temperature gas turbine engines Individual topics studied include film cooling by injection from multirow holes analysis of thermal stresses and creep life of blades under natural convection cooling and film cooling, experiments on film cooling with injection through holes near the leading edge two dimensional cascade tests of an air cooled turbine nozzle and small deviation method for evaluating the effect of cooling air on air cooled turbine performance P T H

A79 30377 # The effect of slot configuration and arrangement on the characteristics of jet flow H Nishimura, H Usui, S Inoue, and F Mimura In Researches on air cooled high temperature turbine Chofu Japan, National Aerospace Laboratory, 1978 p 221 234 In Japanese with abstract in English (NAL TM 195)

In order to obtain high loading of jet engine turbine blades the use of slotted blades is being studied This paper reports on an experimental investigation of the influence of slot configuration and arrangement on the characteristics of jet flow issuing from the slot past the airfoil surface P T H

A79-30378 # Considerations of cooling method of turbine blade from view points of thermal stress and life K Sakata and K Takahara (National Aerospace Laboratory Tokyo, Japan) *(Theoretical and Applied Mechanics,* vol 25 1977 p 627 636) In Researches on air cooled high temperature turbine Chofu Japan National Aerospace Laboratory 1978 p 253 263 7 refs

The effectiveness of pure convection cooling and film cooling with convection cooling of turbine blades was studied on the basis of thermal stress calculations for two simplified models a flat plate model and a circular tube model Calculations show that film cooling is a very efficient means for increasing creep rupture life of high temperature blades as compared with pure convection cooling The thermal stresses are reduced because of the low temperature gradient across the model material P T H

A79 30379 # A two dimensional cascade test of an air cooled turbine nozzle T Yoshida K Takahara, and H Nouse (National Aerospace Laboratory Tokyo, Japan) In Researches on air cooled high temperature turbine Chofu, Japan National Aerospace Laboratory 1978 p 395 403

An experimental investigation was made of the aerodynamic and heat transfer performance of an air cooled nozzle cascade for a high temperature turbine Dimensionless blade surface temperature is kept at a high level by effective impingement and convection cooling These results were compared with a numerical calculation and an analog simulation test and good agreement between them was found (Author)

A70 30380 # An analytical method of evaluating the effect of cooling air on air cooled turbine performance utilizing the small deviation method A Yamamoto, K Takahara and H Usui In Researches on air cooled high temperature turbine Chofu Japan, National Aerospace Laboratory 1978 p 577-599 13 refs In Japanese, with abstract in English (NAL-TM 323)

This paper presents a simple analytical method for air cooled turbine performance utilizing the small deviation method The new method has many advantages the most outstanding of which is the capability of calculating the effects of cooling air on various parameters of turbine performance in a simple manner Various functional relationships including cooling air flow rate and change of flow path area etc are derived for the two stage turbine employed as the example turbine The method was also compared with available experimental data on single-stage turbines The comparison showed good agreement (Author)

A79 30397 * # Tungsten fiber reinforced FeCrAlY A first generation composite turbine blade material D W Petrasek E A Winsa, L J Westfall and R A Signorelli (NASA, Lewis Research Center, Cleveland Ohio) *American Institute of Mining Metallurgical and Petroleum Engineers, Annual Meeting 108th New Orleans, La Feb 18 22 1979, Paper* 27 p 20 refs

General and composite turbine blade material requirements are examined to identify a specific tungsten fiber reinforced superalloy (TFRS) having in addition to strength, the desired combination of other material properties needed in turbine blades Experimental data indicated that a thoriated tungsten fiber reinforced FeCrAlY matrix composite should have the stress rupture creep tensile fatigue and impact strengths required for turbine blades operating from 1250 to 1370 K Fabrication and design concepts are developed to demonstrate the feasibility of fabricating a hollow TFRS turbine blade at reasonable cost A A

A79 30448 Unique environmental test facilities at Orlando Division of Martin Marietta Aerospace J A Roy (Martin Marietta Aerospace, Orlando Fla) *Journal of Environmental Sciences* vol 22 Mar Apr 1979 p 17 21 5 refs

The environmental test facilities at Martin Marietta Aerospace Orlando division are described, considering the Simulation and Test Laboratory (STL), and Conflow Test facility, and the Advanced Centrifuge facility The STL develops evaluates, and verifies performance of a variety of airborne guidance and fire control systems through (1) the Man in the Loop system, testing and evaluating human factors, (2) the Ground Based Laboratory, replacing simulation with actual flight components, (3) Radar Guidance Laboratory, (4) All Weather Test Laboratory and (5) Heliport Flight Laboratory The Conflow facility, consisting of such subsystems as booster transition simulation and aerodynamic heating simulation, provides a ground test capability for the integrated testing of missile systems using air breathing propulsion systems The Advanced Centrifuge facility offers earth stable testing to 250 g in addition to brute force testing of 272 kg packages to 400 g A A

A79 30474 # Numerical solution of a body propeller combination flow including swirl and comparisons with data J A Schetz (Virginia Polytechnic Institute and State University Blacksburg, Va) and S Favin (Johns Hopkins University Laurel Md) *Journal of Hydronautics,* vol 13, Apr 1979 p 46 51 21 refs Contract No N00017 72 C 4401

A numerical procedure based on the full Navier Stokes equations as applied to the flow near a body/propeller system is developed The flow is assumed axisymmetric and the unsteady equations of motion are cast in terms of a stream function one vorticity component and the peripheral velocity The vorticity equation and the peripheral momentum equation are solved by an alternating difference implicit technique and the Poisson equation for the stream function is solved by direct matrix reduction The propeller is modeled as an actuator disk and the direct simulation of a given actual propeller is considered in detail Turbulent transport is modeled by an integrated turbulent kinetic energy equation with a simple extension to represent the effects of swirl Detailed comparisons with wind tunnel measurements at x/D = 2 show a good prediction of the axial velocity but an underprediction of the swirl level It is concluded that a more refined turbulence model incorporating a better representation of the effects of swirl is needed An improved turbulence model can be easily incorporated into the overall calculation procedure when one becomes available (Author)

A79 30480 # An elementary explanation of the flutter mechanism with active feedback controls H Horikawa and E H Dowell (Princeton University Princeton, N J) *Journal of Aircraft* vol 16 Apr 1979, p 225-232 11 refs

An elementary explanation of wing flutter suppression problems with active feedback control is made using a standard root locus technique The object of the study is to obtain insight into the control of converging frequency flutter such as the classical bending torsion flutter of a wing The model analyzed is a two-dimensional, typical section airfoil with pure gain feedback of the main wing motion In this simple system stability boundary solutions are expressed in a closed form and valuable information is obtained for various kinds of feedback signals The results for an exploratory example are discussed The analysis of this example using Nissim's energy method is also attempted (Author)

A79 30481 * # An experimental study of a jet issuing from a lifting wing H M McMahon and D L Antani (Georgia Institute of Technology Atlanta Ga) *Journal of Aircraft,* vol 16 Apr 1979 p 275 281 15 refs Grant No NsG 1257

An experimental program was conducted to determine the behavior of a round turbulent jet issuing from a lifting two-dimensional wing in crossflow The jet was located at 65% wing chord on an NACA 0021 airfoil fitted with a 30% chord NACA 4415 flap The flowfield associated with the jet was surveyed extensively with directional pressure probes to determine local velocity vectors and pressures for three different values of lift coefficient at jet effective velocity ratios (square root of the ratio of the jet dynamic pressure to the freestream dynamic pressure) of 4 6 and 8 Data describing the jet centerline and the path of the contrarotating vortices accompanying the deflected jet are presented and compared with similar data for a round jet issuing from a large flat plate The spacing and strength of the vortices are calculated using a simple vortex model previously proposed for the flat plate case The results show that the penetration of the jet and the vortices increases significantly with increasing lift for the range of test parameters covered in the study The calculated vortex spacing and strength also show an increase with lift (Author)

A79 30482 * # Aircraft wake flow effect and horizontal tail buffet C Hwang and W S Pi (Northrop Corp Hawthorne Calif) *Journal of Aircraft* vol 16, Apr 1979 p 282 284 Contract No NAS2 8734

As part of a program to investigate the fluctuating pressure distribution and response behavior of a fighter aircraft in transonic maneuver, an F 5A scale model has previously been tested in an 11 ft transonic wind tunnel The model with a number of static and dynamic pressure transducers imbedded in the lifting surfaces was tested at various angles of attack up to 16 deg In this paper test results of particular interest to wake flow and horizontal tail buffet are described It is shown that the dynamic pressure data on the tail surface at the specified flight conditions serve to determine the local dynamic loads They also influence the control performance of the aircraft under maneuver conditions where buffet is encountered The data presented demonstrate a number of contributing factors that affect the tail dynamic pressures in the transonic regime S D

A79-30483 # Minimum landing approach distance for a sailplane B L Pierson (Iowa State University of Science and Technology Ames Iowa) and I Chen *Journal of Aircraft* vol 16 Apr 1979 p 287, 288 6 refs Research supported by Iowa State University of Science and Technology

An optimal control problem is formulated in which one seeks the lift coefficient time history that provides the shortest possible landing approach distance for a sailplane under specified assumptions and minimum speed and altitude path constraints imposed on the problem The optical control problem thus formulated is solved using a gradient projection algorithm which incorporates conjugate directions of search for rapid convergence The optimal trajectory is determined and plotted against altitude The minimum landing approach distance is 1317 m and the optimal final time is 65 09 sec Each peak on the optimal trajectory is associated with a near stall A striking feature of the optimal trajectory is its highly oscillatory nature S D

A79 30484 # Very large vehicles To be or W H Arata, Jr (Northrop Corp Los Angeles Calif) *Astronautics and Aeronautics* vol 17 Apr 1979, p 20 25 33 20 refs

Some of the concepts being studied for large aircraft are briefly discussed Concepts for conventional takeoff and landing aircraft, distributed load aircraft wing in ground effect aircraft, multiple fuselages, the laminar flow control aircraft, nuclear powered tug air cushion landing-system aircraft blimp helicopter combination, and surface effect ships are mentioned P T H

A79 30485 # Large vehicle concepts L W Noggle (USAF Aeronautical Systems Div Wright Patterson AFB Ohio) and C E Jobe (USAF, Flight Dynamics Laboratory, Wright Patterson AFB Ohio) *Astronautics and Aeronautics,* vol 17, Apr 1979, p 26 32 18 refs

The paper briefly surveys most of the very large vehicle concepts examined by Air Force Navy NASA, and industry in recent study efforts Some of these include a conventional aircraft capable of carrying a 400 000 lb load over a range of 6200 n mi , a laminar

flow control aircraft where slotted wing and tail surfaces provide laminar flow to 70% chord to conserve fuel nuclear powered aircraft with active controls technology, swept wing space distributed load aircraft capable of carrying a million pounds of payload wing in ground effect vehicles a power augmented ram/wing in ground effect vehicle, and the heavy lift airship P T H

A79 30501 # Experimental and analytical investigation of the effects of Reynolds number and blade surface roughness on multistage axial flow compressors A Schaffler (Motoren und Turbinen Union Munchen GmbH, Munich West Germany) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego Calif , Mar 12 15, 1979, Paper 79 GT 2* 8 p 9 refs Members $1 50 nonmembers $3 00

The effects of Reynolds number and blade surface roughness on multistage axial flow compressors were investigated experimentally and an analytical interpretation of test results is presented A three stage intermediate pressure compressor a five stage high pressure compressor and two modules of a six stage high pressure compressor were tested with different degrees of blade surface roughness in an altitude test chamber to simulate various Reynolds numbers It is found that at high altitude (Reynolds number below 10 to the 5th) laminar separation occurs, resulting in reduced flow and efficiency at intermediate Reynolds number a turbulent attached boundary layer and hydrodynamically smooth blade surfaces are found and at high Reynolds number turbulent attached boundary layer flow with hydrodynamically rough surfaces are observed For rough blades the onset of hydrodynamic roughness is observed at a relatively low Reynolds number (about 3 1 x 10 to the 5th) In the high Reynolds number regime, efficiency is dependent on blade roughness, and the maximum blade surface roughness permissible for hydrodynamically smooth boundary layer flow in high pressure compressors is derived A L W

A79-30503 # Acoustics and performance of high-speed unequally spaced fan rotors S Fujii (National Aerospace Laboratory Chofu Tokyo, Japan) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif Mar 12 15 1979 Paper 79 GT 4* 9 p 12 refs Members $1 50 nonmembers, $3 00 Research supported by the Environmental Protection Agency of Japan

This paper describes an experimental measurement of the effects of uneven blade spacing on the acoustic and aero thermodynamic characteristics of high speed, high pressure ratio fan rotors at two selected spacing configurations A test rig, consisting of inlet guide vanes and transonic rotor blades was employed to explore the redistribution of harmonic sound energy into a series of multiple tones of lower sound pressure level The measured data indicated that a ten percent modulated rotor exhibited a six to eight decibel decrease in the sound pressure level as compared with the original first blade passage frequency harmonic Disadvantages in aerodynamic performance resulting from spacing modulation were not so unfavorable for the ten percent modulated blades However, with five percent modulated blades serious deterioration in aerodynamic performance was observed particularly near the blade tip section which produced an unfavorable acoustic signature A calculation method, assuming a pulse event for each blade sound pressure, provided agreeable results with the measured data (Author)

A79-30504 * # Axial flow compressor turning angle and loss by inviscid viscous interaction blade to blade computation E C Hansen G K Serovy (Iowa State University of Science and Technology, Ames Iowa), and P M Sockol (NASA, Lewis Research Center, Cleveland Ohio) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif Mar 12 15 1979 Paper 79 GT 5* 7 p 27 refs Members, $1 50 nonmembers, $3 00 Grants No NsG 3033 No AF AFOSR-78 3609 Contract No F33615 76 C 2090

A method for computation of the flow field around an arbitrary airfoil cascade on an axially symmetric blade to blade surface was developed which takes into account the development and separation of the blade surface boundary layers and mixing in the wake The method predicts the overall fluid turning and total pressure loss in the context of an inviscid viscous interaction scheme The inviscid flow solution is obtained from a compressible flow matrix method The viscous flow is obtained from a differential boundary layer method which calculates laminar transitional and turbulent boundary layers Provisions for the calculation of laminar and turbulent separation regions were added to the viscous scheme The combined inviscid viscous interaction scheme described yields results which are quantitatively consistent with experimental data This suggests that the physical basis for the interactive system is correct and justifies continued exploration and use of the method (Author)

A79 30507 * # Mean velocity and decay characteristics of the guidevane and stator blade wake of an axial flow compressor B Lakshminarayana and R Davino (Pennsylvania State University University Park Pa) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego Calif , Mar 12 15, 1979 Paper 79 GT 9* 11 p 15 refs Members $1 50 nonmembers $3 00 Grants No NsG 3012, No NsG 3032

Pure tone noise blade row vibrations and aerodynamic losses are phenomena which are influenced by stator and IGV (inlet guide vane) blade wake production decay and interaction in an axial flow compressor The objective of this investigation is to develop a better understanding of the nature of stator and IGV blade wakes that are influenced by the presence of centrifugal forces due to flow curvature A single sensor hot wire probe was employed to determine the three mean velocity components of stator and IGV wakes of a single stage compressor These wake profiles indicated a varying decay rate of the tangential and axial wake velocity components and a wake profile similarity An analysis which predicts this trend has been developed The radial velocities are found to be appreciable in both IGV and the stator wakes (Author)

A79-30508 # Augmented vectored thrust engines and the problem of avoiding hot gas recirculation W J Lewis and R Hurd (Rolls Royce Ltd , Bristol, England) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego Calif , Mar 12-15 1979, Paper 79 GT 10* 7 p Members, $1 50 nonmembers $3 00

It can be argued that the vectored thrust engine is one of the best propulsion systems for V/STOL combat aircraft The next step is to consider the problems to be overcome in integrating such a powerplant into the airframe A critical installation issue and one which is not unique to vectored thrust systems is that of hot exhaust gas recirculation In this paper some of Rolls Royce s hot gas recirculation experience is described covering in particular the creation of a specialized recirculation test facility and some sample test results The application of the results to a vectored thrust installation is discussed, together with some of the implications for the aircraft designer Finally some comments are made regarding the requirements of other V/STOL propulsion systems to avoid excessive hot gas recirculation (Author)

A79 30514 # Heat transfer to turbine blades, with special reference to the effects of mainstream turbulence A Brown and B W Martin (University of Wales Institute of Science and Technology, Cardiff Wales) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego, Calif , Mar 12 15, 1979, Paper 79 GT 26* 12 p 62 refs Members $1 50 nonmembers, $3 00

The mainly empirical criteria used to predict the boundary layer behavior under the combined influence of velocity gradient factor and significant mainstream turbulence are reviewed and assessed by application to recently published blade heat transfer measurements Indications are that under the conditions experienced in gas turbine engines the scale and frequency of mainstream turbulence may be as

important as its intensity in determining local heat transfer coefficients round the blades (Author)

A79-30515 # **Determination of heat transfer coefficients around a blade surface from temperature measurements** D K Mukherjee (Brown, Boveri et Cie AG Baden, Switzerland) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego Calif Mar 12-15, 1979, Paper 79 GT 28* 9 p 12 refs Members $1 50 nonmembers, $3 00

To design cooled gas turbine blades heat transfer coefficients around its surface are required The calculated heat transfer data under operating conditions in the turbine are often inaccurate and require experimental verification A method is presented here to determine the heat transfer coefficients around the blade surface and in the coolant channels This requires measurements of the main stream and coolant temperatures together with the outer surface temperature distribution at varying mass flows In order to conduct these tests in a gas turbine test blades have to be specially prepared allowing the variation and measurement of coolant mass flow (Author)

A79-30516 # **Computation of supercritical compressor and turbine cascades with a design method for transonic flows** E Schmidt (Stuttgart Universitat Stuttgart, West Germany) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego, Calif Mar 12 15 1979, Paper 79 GT 30* 7 p 15 refs Members, $1 50, nonmembers $3 00

The development of supercritical cascades follows experience with supercritical single profiles In cascade arrangement strong inter blade influences exist in the transonic region, so that a desired pressure distribution starting from the contour shape is not easy to realize. For these cases a design method has been developed in which the boundary conditions can be prescribed in a simple and clear manner Thickness and deflection are not restricted, since the full potential equation is treated Variation of the axial velocity density ratio is provided for The solution by relaxation leads to short computing times Environmental comparisons for turbine and compressor cascades show the applicability of the method (Author)

A79 30517 # **Influence of freely rotating inlet guide vanes on the return flows and stable operating range of an axial flow fan** N Venkatrayulu and D Prithvi Raj (Indian Institute of Technology Madras India) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego Calif, Mar 12 15 1979, Paper 79 GT-31* 6 p 10 refs Members $1 50 nonmembers $3 00

This paper presents the results of experimental investigations on the three-dimensional flow and performance characteristics of a free vortex axial flow fan rotor, with a freely rotating and braked inlet guide vane row The influences of axial distance between the inlet guide vane row and the rotor inlet, inlet guide vane setting angle and shape partial omission of guide vanes at the hub and tip regions on the return flows have been studied and optimum axial distance and setting angle that will improve the useful operating range of the fan were determined Use of freely rotating inlet guide vanes at high flow volumes and braked inlet guide vanes at low flow coefficients resulted in a reduction of return flows and an increase of the stable operating range of the axial fan rotor by more than 35 percent and this combination has yielded higher efficiencies as well in the extended region of stable operation (Author)

A79 30518 # **An experimental investigation of film cooling on a turbine rotor blade** R P Dring M F Blair and H D Joslyn (United Technologies Research Center East Hartford Conn) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego, Calif Mar 12 15 1979 Paper 79 GT 32* 7 p 14 refs USAF sponsored research

Results are presented for an experimental study of film cooling on the rotor blade of a large scale (low-speed) model of a high-pressure turbine first stage Two coolant hole locations are considered one at midspan and 10% axial chord on the suction surface and one at midspan and 16% axial chord on the pressure surface Both surface flow visualization and local film cooling adiabatic effectiveness data are obtained Attention is given to a discussion of qualitative and quantitative differences observed between the behavior of film coolant on the suction and pressure surfaces of a turbine rotor blade In particular the film coolant trajectories for each blowing site are virtually unaffected by the coolant blowing rate and the coolant to free stream density ratio S D

A79 30519 # **Study of mean and turbulent velocity fields in a large-scale turbine-vane passage** D A Bailey (United Technologies Research Center, East Hartford, Conn) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego Calif , Mar 12 15 1979, Paper 79 GT 33* 8 p 24 refs Members $1 50 nonmembers $3 00

Laser Doppler velocimetry was used to investigate the secondary flow in the endwall region of a large scale turbine inlet guide vane passage The mean and turbulent velocities were measured for three different test conditions The different test conditions consisted of variations in the blade aspect ratio and the inlet boundary layer thickness or all three cases, a passage vortex was identified and its development documented The turbulent stresses within the vortex were found to be quite low in comparison with the turbulence in the inlet boundary layer (Author)

A79 30520 # **The effects of coolant air inlet conditions on the flow regime between a turbine disk and its casing** T Uzkan (Bogazici University, Bebek Turkey) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego, Calif Mar 12-15 1979, Paper 79 GT-35* 11 p 9 refs Members, $1 50 nonmembers $3 00

A method to predict the performance of the incompressible turbulent flow between a rotating disk and a parallel stationary wall when there is radial outflow of ventilation air, is presented Using this method, the effects of the ventilation air inlet conditions on the core rotation, on the radial velocity profile development, on the radial inflow rates on the separation streamlines between outflow and inflow regions and on the disk torque coefficient are calculated and presented The method is general enough to calculate other effects The important conclusions for the analysis of ventilation air inlet conditions are (1) the inlet radial velocity profile should be skewed toward the stationary wall, to more effectively prevent radial inflow, (2) the disk friction can be decreased by increasing the rotation of the ventilation air (Author)

A79-30521 * # **Effect of rotor tip clearance and configuration on overall performance of a 12.77 centimeter tip diameter axial flow turbine.** J E Haas (USAF Aero Propulsion Laboratory Wright-Patterson AFB Ohio) and M G Kofskey (NASA Lewis Research Center Cleveland Ohio) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12 15, 1979 Paper 79 GT 42* 9 p 7 refs Members, $1 50, nonmembers, $3 00

An extensive experimental investigation was made to determine the effect of varying the rotor tip clearance of a 12 77 cm tip diameter, single stage axial flow reaction turbine In this investigation the rotor tip clearance was obtained by use of a recess in the casing above the rotor blades and also by use of a reduced blade height For the recessed casing configuration, the optimum rotor blade height was found to be the one where the rotor tip diameter was equal to the stator tip diameter The tip clearance loss associated with this optimum recessed casing configuration was less than that for the reduced blade height configuration (Author)

A79 30523 # **Future tactical fighter requirements A propulsion technology update** G W Lind and T S Ervolina (Grumman Aerospace Corp , Bethpage N Y) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego, Calif Mar 12 15 1979, Paper 79 GT-46* 9 p 8 refs

A survey is presented of the progress and activities undertaken in pursuit of efficient supersonic cruise within the constraints of future tactical roles The developing roles of future tactical fighters are outlined from the basic supersonic penetration mission to design alternatives such as STOL capability In each case the predominant effect on the candidate propulsion design process is to establish the configuration which best resolves a solution in terms of the advanced technology projections Each role whether directed toward high Mach number cruise or high transonic maneuvering suggests a supersonic cruise requirement Sufficient wind tunnel tests are conducted to indicate that propulsion technology when integrated properly, can meet this challenge Stealth implications are part of the overall propulsion/weapon system tradeoffs S D

A79-30527 * # An approach to optimum subsonic inlet design R W Luidens N O Stockman and J H Diedrich (NASA Lewis Research Center, Cleveland Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego Calif Mar 12-15 1979 Paper 79 GT-51* 10 p 21 refs Members, $1 50, nonmembers $3 00

The approach consists of comparing inlet operating requirements with estimated inlet separation characteristics to identify the most critical inlet operating condition This critical condition is taken to be the design point and is defined by the values of inlet mass flow free stream velocity and inlet angle of attack Optimum flow distributions on the inlet surface are determined to be a high flat top Mach number distribution on the inlet lip to turn the flow quickly into the inlet and a low flat bottom skin friction distribution on the diffuser wall to diffuse the flow rapidly and efficiently to the velocity required at the fan face These optimum distributions are then modified to achieve other desirable flow characteristics Example applications are given Extension of the method is suggested (Author)

A79 30528 # Internal aerodynamics and heat transfer problems associated to film cooling of gas turbines E Le Grives J J Nicolas and J Genot (ONERA Chatillon sous Bagneux Hauts de Seine France) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego Calif , Mar 12 15, 1979 Paper 79 GT-57* 13 p 7 refs Members, $1 50 nonmembers, $3 00 (ONERA TP no 1979 16)

With a view to collect data of interest for the computation of temperature and stress distributions in turbine disks and blades the main features of these convection processes are investigated A description of specially devised test rigs affording adequate similitude of Reynolds or Mach numbers and of coolant to main stream temperature ratios is given along with the experimental methodology used in steady state or transient wind tunnel operation Attention is given to heat transfer through multihole parts of turbine airfoils, aerodynamics of flows within perforated ducts, and heat transfer over a perforated wall Experimental data are discussed relative to the desired accuracy for heat transfer prediction for air cooled gas turbines except for the effects of rotation S D

A79-30553 * # Thermal structural mission analyses of air cooled gas turbine blades A Kaufman and R E Gaugler (NASA Lewis Research Center, Cleveland Ohio) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego, Calif Mar 12 15 1979 Paper 79 GT 19* 11 p 8 refs

Cyclic temperature and stress strain states in cooled turbine blades were calculated for a simulated mission of an advanced technology aircraft engine TACTI (three dimensional heat transfer) and MARC (nonlinear structural analysis) computer programs were used to analyze impingement cooled airfoils, with and without leading edge film cooling Creep was the predominant damage mode particularly around film cooling holes Radially angled holes exhibited less creep than holes normal to surface Beam type analyses of all impingement cooled airfoils gave fair agreement with MARC results for initial creep (Author)

A79 30555 * # High freezing-point fuels used for aviation turbine engines R Friedman (NASA Lewis Research Center Cleveland Ohio) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego, Calif Mar 12 15 1979 Paper 79 GT-141* 12 p 21 refs

Broadened specification aviation fuels could be produced from a greater fraction of crude source material with improvements in fuel supply and price These fuels particularly those with increased final boiling temperatures, would have higher freezing temperatures than current aviation turbine fuels The higher freezing point fuels can be substituted in the majority of present commercial flights since temperature data indicate that in flight fuel temperatures are relatively mild For the small but significant fraction of commercial flights where low fuel temperatures make higher freezing point fuel use unacceptable adaptations to the fuel or fuel system may be made to accommodate this fuel Several techniques are discussed Fuel heating is the most promising concept One simple system design uses existing heat rejection from the fuel lubricating oil cooler another uses an engine-driven generator for electrical heating Both systems offer advantages that outweigh the obvious penalties (Author)

A79 30557 * # The Advanced Low Emissions Catalytic Combustor Program Phase I - Description and status A J Szaniszlo (NASA, Lewis Research Center, Cleveland Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego Calif Mar 12 15 1979 Paper 79 GT-192* 11 p 22 refs

The Advanced Low Emissions Catalytic Combustor Program is an ongoing three phase contract effort with the primary objective of evolving the technology required for incorporating catalytic combustors into advanced aircraft gas turbine engines Phase I is currently in progress At the present time, analytical evaluation is being conducted on advanced catalytic combustor concepts including variable geometry, with their known inherent potential advantages of low level pollutant emissions, widened combustion stability limits, and reduced pattern factor for longer turbine life Phases II and III will consist of experimental evaluation of the most promising concepts (Author)

A79-30558 * # Experimental evaluation of the effect of inlet distortion on compressor blade vibrations J F Lubomski (NASA Lewis Research Center Cleveland Ohio) *American Society of Mechanical Engineers Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego Calif , Mar 12 15 1979, Paper* 15 p 7 refs

Compressor rotor strain gage data from an engine test conducted with an inlet screen distortion were reduced and analyzed The data were compared to results obtained from the same engine without inlet pressure distortion to determine the net effect of the distortion on the vibratory response of the compressor blades The effect of the distortion was found to be most prominent in the first three compressor stages with the rotor speed establishing the period of the complex wave and, consequently, the frequencies of all the higher engine order excitations At certain speeds it was observed that the complex pressure wave had the frequency content to excite a number of modes simultaneously although the overall magnitudes were small and well within allowable stress limits A A

A79 30559 * # Effect of flight loads on turbofan engine performance deterioration E G Stakolich (NASA Lewis Research Center, Cleveland Ohio), A Jay, E S Todd (United Technologies Corp Pratt and Whitney Aircraft East Hartford Conn), P G Kafka and J L White (Boeing Commercial Airplane Co , Renton, Wash) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference, San Diego, Calif , Mar 12-15 1979, Paper* 21 p

A significant percentage of high bypass ratio turbofan engine performance deterioration is caused by an increase in operating clearance between fan/compressor and turbine blades and their outer air seals These increased clearances result from rubs induced by a

combination of engine power transients and aircraft flight loads An analytical technique for predicting the effect of quasi steady state aircraft flight loads on engine performance deterioration has been developed and is presented Thrust aerodynamic and inertia loads are considered Analytical results are shown and compared to actual engine test experience (Author)

A79 30560 * # The GATE studies - Assessing the potential of future small general aviation turbine engines W C Strack (NASA, Lewis Research Center, Cleveland Ohio) *American Society of Mechanical Engineers, Gas Turbine Conference and Exhibit and Solar Energy Conference San Diego, Calif Mar 12 15, 1979 Paper* 22 p

Four studies have been completed that explore the opportunities for future General Aviation Turbine Engines (GATE) in the 150 1000 SHP class These studies forecasted the potential impact of advanced technology turbine engines in the post 1988 market identified important aircraft and missions desirable engine sizes engine performance and cost goals Parametric evaluations of various engine cycles, configurations design features and advanced technology elements defined baseline conceptual engines for each of the important missions identified by the market analysis Both fixed wing and helicopter aircraft, and turboshaft turboprop and turbofan engines were considered Key technology areas were recommended for NASA support in order to realize proposed improvements (Author)

A79 30580 # Rolls Royce Adour T Ford *Aircraft Engineering* vol 51, Mar 1979 p 2 5

The Rolls Royce Adour engine available with and without thrust augmentation by afterburning is discussed Design features are considered, noting that the fuel control system operates basically by throttle lever position through combined shut off and throttle valves with the control amplifier limiting the exhaust gas temperature Improved versions are taken into account including the Mk 804 where increased thrust is provided by operating at higher engine and afterburner temperatures Overhaul and maintenance are examined indicating that by adopting module exchange the restriction of a single time between overhauls for a complete engine is removed A A

A79-30581 # Aircraft engine emissions are under continuing surveillance L F Mortimer (International Civil Aviation Organization, Air Navigation Bureau Montreal Canada) *Aircraft Engineering*, vol 51, Mar 1979 p 6 8

Surveillance of aircraft engine emissions by ICAO is discussed Basic pollutants and aircraft pollution are considered noting that airports in general do not have a significant adverse impact on the air quality in the surrounding region The concern with the effects of pollution in the stratosphere is taken into account, indicating that latest research suggests the possibility that exhaust emissions might be increasing ozone, rather than destroying it Programs of ICAO are mentioned A A

A79 30582 # Aerodynamics of engine air intakes M N D Welte and W Schmidt *Aircraft Engineering* vol 51 Mar 1979 p 9 10

Intensive preliminary technological work is being carried out in the Federal Republic of Germany on the development of a new tactical combat aircraft A project for expanding and improving the knowledge necessary for the design of engine air intakes is described The basic problem is to find an engine air intake making possible good flying performance and characteristics for a future supersonic combat aircraft at transonic flying speeds and ensuring good acceleration capabilities in the high supersonic range The project consists of a theoretical part where calculation methods for handling intake flows are developed, and an experimental part where testing equipment is developed and designs of intakes are tried out The present model is being tested with the aid of 150 static pressure holes on the fuselage and air intake for total pressure measurements at 125 points in the compressor entrance plane A A

A79-30583 # Design to cost and Aérospatiale s Aircraft Division A Etesse (Societe Nationale Industrielle Aerospatiale Aircraft Div Paris, France) *Aircraft Engineering* vol 51, Mar 1979 p 23-25

The Aerospatiale design for optimum cost method derived from the design-to cost control method and intended for new civil aircraft programs, is discussed The method offers a new approach to the problem of cost and selling prices in that in addition to its analytical aspects and the systematic analysis of all costs it allows efficient collaboration at each stage in the project between the different departments involved in the program Studies for the new A200 aircraft were conducted by applying the method and the results have shown to be favorable A A

A79-30608 # Approximate analysis of strake wings at low speeds S K Chakrabartty and B C Basu (Indian Institute of Technology, Kharagpur India) *AIAA Journal*, vol 17, Apr 1979, p 432 434 7 refs

A method is proposed for the analysis of flow past strake wings when there is separated flow present An approximate approach is taken where slender wing theory is used for the separated flow on the forward highly swept part (strake) the upwash field from this then being fed into lifting surface theory Attention is restricted to strakes having straight leading edges, so Brown and Michael s (1955) separated flow theory can be applied A computer program was developed to find the vortex strength distribution chordwise and spanwise load distribution and the overall characteristics of the wing Good agreement of numerical with experimental results for three different wings at various angles of attack was obtained P T H

A79 30610 # Subsonic base pressure fluctuations R A Merz (USAF, Institute of Technology, Wright Patterson AFB, Ohio) *AIAA Journal*, vol 17 Apr 1979, p 436 438 5 refs Research supported by the Emil Buehler Fund and Rutgers University

The base pressure fluctuations on an axisymmetric blunt based body at subsonic speeds were investigated in tests conducted over the entire subsonic Mach number range in a special wind tunnel that was free of support interference The magnitudes of the fluctuations were found to be significant and increased with increasing Mach number Magnitudes between 120 dB and 150 dB were observed An average frequency and Strouhal number were found to decrease with increasing Mach number Average frequencies between 1000 Hz and 2000 Hz were observed while Strouhal numbers were between 0 05 and 0 5 P T H

A79-30644 Some TIG welding applications in the aerospace industry J G Anderton In TIG and plasma welding Abington, Cambs , England Welding Institute, 1978 p 22 26

Examples of TIG welding applications in the aerospace industry are discussed together with a review of the merits of the TIG and plasma processes using both continuous and pulsed techniques for the production of butt welds The production of pressure vessels, involving the use of forgings, spinnings, pressing and deep drawings is considered noting that the majority of applications are carried out using manual or semi mechanized TIG techniques The production of motor cases and associated hardware is taken into account indicating that TIG techniques are preferred for the fabrication of aluminum pipework while the plasma process is regarded as an alternative method for the production of tubes by the helical route A A

A79 30690 # Study of some characteristics of helicopter rotor operation on the basis of a numerical experiment (Izuchenie nekotorykh osobennostei raboty nesushchego vinta chislennym eksperimentom) S M Belotserkovskii, V A Vasin and B E Loktev *Akademiia Nauk SSSR, Doklady*, vol 244, Jan 11 1979 p 312 315 7 refs In Russian

The present analysis deals with such special modes of rotor operation as sudden braking during axial descent sudden rapid

changes in altitude in the upward and downward directions and hover or longitudinal flight, in the presence of the ground effect Some characteristics of operation under such conditions are identified for a two-bladed rotor with rigid flat rectangular blades V P

A79 30784 # Low profile polarization cage for VOR S antennas H O Berner (Standard Elektrik Lorenz AG Stuttgart West Germany) *Electrical Communication* vol 53 no 4 1978, p 296 300 7 refs

The polarization cage used for the VOR S system is only half the height of the first generation cage which was unwieldy and a hazard to aircraft because of its height During in flight tests, both the 1 and 2 element antenna versions have been proved virtually to eliminate vertical field components at the 20-deg design elevation (Author)

A79-30922 The development of high lift single-component airfoil sections J L Kennedy and D J Marsden (Alberta, University Edmonton, Canada) *Aeronautical Quarterly*, vol 30 Feb 1979 p 343 359 16 refs

A single element wing section has been tested in a wind tunnel to study the effects of camber near the trailing edge on the lift coefficient Significant gains in lift coefficient are possible if the velocity at the trailing edge on the upper surface of the wing section is increased Considerable amounts of rear loading at the trailing edge are needed to increase the upper surface trailing edge velocity, such rear loading, however, affects potential flow pressure distributions Nevertheless, large amounts of rear loading result in higher lift coefficients than ever previously recorded for single element wing sections J M B

A79 30923 The effect of chordwise flexibility on the lift of a rapidly accelerated airfoil J Katz and D Weihs (Technion Israel Institute of Technology, Haifa, Israel) *Aeronautical Quarterly*, vol 30 Feb 1979 p 360-370 12 refs

The effects of finite chordwise flexibility on the development of lift on a rapidly started airfoil are studied This is a generalization of the so called Wagner problem of unsteady aerodynamics It is found that the lift varies with time in a nonmonotonous fashion including more than one extremum The lift at large times is found to be lower the more flexible the foil Changes in the wake vortex sheet are also discussed (Author)

A79-30932 # Tokyo s new Narita airport An illusion K Fujita In Annals of air and space law Volume 3 Toronto Carswell Co Ltd Paris Editions A Pedone 1978 p 121 132 10 refs

Narita airport opened officially in 1978 after a seven year delay, has been plagued by local opposition and has encountered difficulties due to the distance of the airport from Tokyo and the high landing fees necessitated by the five billion dollar construction investment A review of the decision process leading up to the site selection shows a lack of concern for local interests and a failure to consider the usefulness of offshore siting for future supersonic services Problems related to jet fuel transportation to Narita and noise abatement in the airport vicinity also receive attention J M B

A79-30933 # Responsibilities of French air traffic control (La responsabilite des services de la circulation aérienne en France) G Guillaume (Conseil d Etat, Paris, France) In Annals of air and space law Volume 3 Toronto, Carswell Co, Ltd, Paris Editions A Pedone 1978 p 133 141 18 refs In French

The limits of liability of the French air traffic control system are discussed General principles governing compensation for damages caused by the functioning of a public service are reviewed with attention given to both criminal and civil actions The distinction between damages for which airport authorities are liable and damages for which the air traffic control service may be held responsible is emphasized J M B

A79 30940 # Problems of airports in the vicinity of foreign states W Schwenk (Bundesministerium fur Verkehr, Bonn, West Germany) In Annals of air and space law Volume 3 Toronto Carswell Co Ltd, Paris Editions A Pedone 1978 p 225 235 14 refs

Legal questions raised by airports situated near international borders are discussed, with special reference to Salzburg airport in Austria and Zurich airport in Switzerland Among the problems created by frontier airports are obstacle clearance for the benefit of the frontier airport in the territory of the foreign country, noise control over the foreign territory, and the necessity of overflights on the foreign country during takeoff and landing In general, bilateral agreements have been adopted to resolve these difficulties International cooperation in air traffic services in the vicinity of frontier airports is also considered J M B

A79-30941 # Considerations in local administration of airports in Canada J J Smith (McGill University, Montreal Canada) In Annals of air and space law Volume 3 Toronto, Carswell Co, Ltd, Paris, Editions A Pedone 1978 p 237 260 51 refs

Canadian airport administration is at present almost entirely under the jurisdiction of the national Department of Transport Canadian airport administration is constrained by facts of geography and population, and the national administration seems advisable in most cases Nevertheless, possibilities for effective local administration exist at Toronto, Vancouver and Winnipeg Arguments for local airport administration at these locations are supported by reference to maritime parallels the British Airports Authority the Aeroport de Paris Kansas City International Airport, and the Metropolitan Nashville Airport Authority J M B

A79 30943 # Wake turbulence and the jumbo jets - Whose responsibility, pilot or controller F M Troncoso (Fiddler Gonzalez and Rodriguez, P R) and A B Feldman In Annals of air and space law Volume 3 Toronto, Carswell Co Ltd, Paris Editions A Pedone, 1978, p 269 285 72 refs

Case law regarding the wake turbulence danger for small aircraft operating near jumbo jets is reviewed One of the questions arising in the cases studied is whether the controller has a duty to provide wake turbulence warnings, or whether it is the pilot s duty to avoid the vortices A finding of wake turbulence does not necessarily mean that the Government bears responsibility for negligence the determination of duty and proximate cause is essential to the resolution of the cases J M B

A79 31021 The European transonic wind tunnel project J P Hartzuiker and R J North (Nationaal Lucht en Ruimtevaart laboratorium, Amsterdam Netherlands) In ICEC 7 Proceedings of the Seventh International Cryogenic Engineering Conference, London England July 4-7 1978 Guildford Surrey England IPC Science and Technology Press Ltd 1978, p 322 330 8 refs

In 1978 four European nations agreed to cooperate in developing a large transonic high Reynolds number wind tunnel which would use cold N2 gas as the test medium A test section size of 1 95 m x 1 65 m is envisaged A continuous fan drive would provide runs with 10 periods of data acquisition each lasting 10 sec a typical day could yield four runs Cryogenic engineering problems related to the construction of the wind tunnel are also considered J M B

A79-31029 # Fatigue data on a variety of non woven glass composites for helicopter rotor blades J W Davis and G J Sundsrud (3M Co, Industrial Specialties Div, St Paul Minn) In Reinforcing the future Proceedings of the Thirty-fourth Annual Conference, New Orleans, La January 30 February 2 1979 New York, Society of the Plastics Industry Inc, 1979, p 15 F 1 to 15 F 5

A series of thirty alternating stress versus cycles to failure (S N) curves have been developed for a number of the raw material variables in nonwoven glass fiber reinforced epoxy composites These variables include glass type glass fiber finish glass fiber suppliers, fiber bundle size, and resin studies Both an all unidirectional 0 deg, and a bias, + or - 45 deg orientation were used in the tensile tensile fatigue tests The S-N curves indicate differences in the reproducibili ty and data scatter in the two orientations studied The 0-deg orientation gave greater scatter in data than the + or 45 deg orientation Of the two orientations used the + or - 45 deg orientation gave greater spread between the variables being studied The variation between the poorest and best materials tested was 85% There were significant differences noted due to glass finish, fiber bundle size and resins in this study (Author)

A79-31039 # **The development of a cure cycle for C-10 phthalocyanine graphite fiber fiber composites** R Y Ting and H C Nash (U S Navy, Naval Research Laboratory, Washington D C) In Reinforcing the future Proceedings of the Thirty fourth Annual Conference, New Orleans La January 30 February 2, 1979 New York Society of the Plastics Industry, Inc , 1979, p 22 F 1 to 22 F 6 12 refs

Phthalocyanine resins, because of their high glass transition temperature and superior thermal stability are being evaluated for potential high temperature applications as matrix materials in composites for advanced V-STOL aircraft Processes for producing unidirectional prepreg tapes with graphite fiber reinforcements were successfully developed Techniques including differential scanning calorimetry and thermal gravimetric analysis were used to obtain sufficient information about the prepreg material prior to laminate fabrication In situ dynamic dielectric analysis was also carried out to monitor the cure of composite samples during the press cycle The results of these studies are presented and discussed (Author)

A79-31121 * # **Advanced air transport concepts** J K Mollon (NASA, Langley Research Center, Aeronautical System Div, Hampton, Va) *AIAA Student Journal*, vol 17, Spring 1979, p 12 16 6 refs

The concepts of laminar flow control, very large all wing aircraft, an aerial relay transportation system and alternative fuels which would enable large improvements in fuel conservation in air transportation in the 1990's are discussed Laminar boundary layer control through suction would greatly reduce skin friction and has been reported to reduce fuel consumption by up to 29% Distributed load aircraft, in which all fuel and payload are carried in the wing and the fuselage is absent, permit the use of lighter construction materials and the elimination of fuselage and tail drag Spanloader aircraft with laminar flow control could be used in an aerial relay transportation system which would employ a network of continuously flying liners supplied with fuel, cargo and crews by smaller feeder aircraft Liquid hydrogen and methane fuels derived from coal are shown to be more weight efficient and less costly than coal derived synthetic jet fuels A L W

A79-31143 # **Facility for studying the action of unsteady supersonic gas streams on the blades of a plane cascade (Ustanovka dlia issledovaniia vozdeistviia nestatsionarnogo sverkhzvukovogo potoka gaza na lopatki ploskoi reshetki)** B J Buryshev and A G Navrotskii *Problemy Prochnosti* Feb 1979, p 85 87 7 refs In Russian

A79-31157 **Computers on the airliner flight deck.** M Hirst *Flight International* vol 115, Mar 31 1979, p 984-986 989

Design and airline applications of microprocessors are discussed Analogue and digital systems, used in microprocessors are compared noting that the first employ continuous signals while the latter, sets of pulses to represent numerical values The memory and the processor components are reviewed, together with a description of the programming procedure The Inertial Navigation System, feeding steering data directly to the autopilot, is considered, as is the Flight Management System, whose equipment stores a program representing the aircraft's performance tables and is wired to receive data from various aircraft sensors the fuel system, and the crew The data bus concept, used in the newest airline standard avionics equipment designed to exchange information is examined A A

A79-31170 **A review of tail rotor design and performance** C V Cook (Westland Helicopters Ltd , Yeovil, Somerset, England) *Vertica*, vol 2, no 3 4, 1978 p 163 181 23 refs

Over the last 8 to 10 years a great deal of research and development has gone into the improvement of tail rotor performance and design Modern tail rotors have improved thrust/power ratios possess better handling characteristics are lighter simpler and more robust than their predecessors This review attempts to summarize the major areas of improvement over the last decade and makes some suggestions on future requirements (Author)

A79-31171 **Development of linear and non linear hub springs for two-bladed rotors** J M Drees, L W Dooley and B L Blankenship (Bell Helicopter Textron Fort Worth, Tex) *(European Rotorcraft and Powered Lift Aircraft Forum, 3rd Aix-en Provence, France, Sept. 7 9, 1977) Vertica*, vol 2 no 3-4, 1978 p 199 215 9 refs

Advanced two bladed rotor systems may have hub springs for improved control and stability The paper will discuss the results of early tests with locked out flapping hinge (very stiff hub spring), followed by the introduction of metal torsion hub springs culminat ing in recent flight tests with linear and nonlinear elastomeric hub springs The elastomeric hub springs have demonstrated enhanced handling qualities and reduced pilot workload improved low-g capability, and increased center of gravity range with little degrada tion in fuselage vibration or rotor component life The paper concludes with speculations concerning the feasibility of the most simple of all rotor systems the bearingless two-bladed rotor (Author)

A79-31172 **Advanced technology applied to the UH 60A and S 76 helicopters** W F Paul and R Zincone (United Technolo gies Corp , Sikorsky Aircraft Div , Stratford Conn) *(European Rotorcraft and Powered Lift Aircraft Forum, 3rd Aix-en Provence, France, Sept. 7-9, 1977) Vertica*, vol 2, no 3 4 1978, p 233 263

The U S Army Utility Tactical Transport Helicopter was designed to climb vertically at a rate of 450 ft/min at 4000 ft with a full load and to cruise at 150 kt Reliability and maintenance requirements for the helicopter led to such innovative design concepts as the elastomeric rotor the bearingless tail rotor the titanium spar blade, digital electronic stick force augmentation and a modularized main transmission Crashworthiness features included an energy absorbing landing gear designed to meet a 42 ft/sec vertical landing impact Many of these design innovations have also been applied to the development of a light helicopter intended for conveying personnel to offshore oil installations J M B

A79 31173 **VTOL aircraft optimal state space tracking control** C R Guy (Aeronautical Research Laboratories Melbourne Australia) *Vertica*, vol 2, no 3-4 1978 p 265 274 12 refs

Control laws for a jet lift VTOL aircraft automatic landing system are synthesized using linear optimal control theory applied in the tracking mode Only the low speed and touchdown regions of the flight envelope are considered A mathematical model representing the dynamic flight behavior of the Short SC1 aircraft is used in the study and a suitable landing flight path for this vehicle is outlined A brief review of optimal control theory is given followed by the formulation of the state equations The performance criterion is then constructed and the controller design procedure demonstrated Results illustrate that the control laws give excellent performance in all planes (Author)

A79 31236 **Tactical pilotless aircraft - Do they really have a future** C Bulloch *Interavia* vol 34 Apr 1979 p 335 338

Configuration and tactical roles of pilotless aircraft are dis cussed, together with a review of a Navy program projected to devise

a vehicle launchable in a tail sitting attitude from vessels not otherwise equipped to handle aircraft There are three basic types of pilotless aircraft (1) drones needing no human intervention after launching (2) remotely piloted vehicles (RPVs) tracked and controlled by an operator located near the forward edge of the battle area, and (3) hybrid systems utilizing a planned mission program together with remote pilotage for the launch and recovery phases The classic configuration for drones and RPVs has been a small aircraft or missile shaped body powered by a turbojet engine with 57-770 kg thrust The vehicles are generally launched by a solid rocket booster technique and recovered by parachute Of the various military applications of the pilotless aircraft battlefield surveillance, saturation and harassment are the most important A A

A79-31237 Two versions of the F-18 in hot competition J P Geddes *Interavia,* vol 34, Apr 1979 p 351 356

The A and L versions of the F 18 aircraft are discussed The current and potential marketing status of the F 18A is considered, noting that the producer may advertise it as a land based fighter The F 18A is compared with the F 15 indicating that both have been designed for lower life cycle costs than earlier fighters, with the F-18A having more built in avionic systems for the air to ground attack role than the F 15 The marketing potential and the configuration of the F 18L are described Structural and operational parameters of the A and L versions are presented A A

A79 31247 A calculation procedure for three dimensional time dependent, inviscid compressible flow through turbomachine blades of any geometry C Bosman and J Highton (Manchester, Victoria University, Manchester, England) *Journal of Mechanical Engineering Science,* vol 21 Feb 1979, p 39 49 15 refs

A method for calculating three dimensional, time dependent, inviscid, subsonic flow is presented Application is made to flow through the rotor of a small radial inflow turbine and comparison with conventional through flow calculations and experimental results is made The nature of the strong secondary flow in this rotor indicates the probable inadequacy of the two dimensional calcula tions which is confirmed by the comparison (Author)

A79-31388 Acceleration of unbalanced flexible rotors through the critical speeds R Gasch, R Markert, and H Pfützner (Berlin Technische Universitat, Berlin, West Germany) *Journal of Sound and Vibration* vol 63, Apr 8, 1979, p 393-409 14 refs

The bending vibrational behaviour of a flexible rotor with a continuous mass distribution passing its critical speeds under a driving torque is considered It is shown that the (non linear) equations of motion for an actual shaft can be formally traced back to those of a Laval rotor In this way, the results for a Laval rotor, which, in an earlier publication by the authors, have been presented generally for constant load torque can be applied to actual rotors The system parameters of the Laval rotor merely have to be replaced by the generalized parameters of the respective bending modes A special study shows that the effect of the torsional flexibility of the shaft on the bending vibrational behaviour is negligible (Author)

A79-31390 On the balancing convergence of flexible rotors, with special reference to asymmetric rotors Y Matsukura, M Kiso, T Inoue, and M Tomisawa (Mitsubishi Electric Corp Central Research Laboratory Amagasaki Japan) *Journal of Sound and Vibration,* vol 63, Apr 8, 1979, p 419 428 6 refs

It is desirable to be able to balance flexible rotors optimally when making a set of several balancing compensations under workshop conditions, where repetitive running conditions are not always expected and errors in measurements easily appear Con vergent and divergent residual unbalances have been theoretically predicted and experimentally observed in a series of balancing procedures in which the conventional balancing method for sym metric rotors has been applied to that of asymmetric rotors, of which the flexural rigidities on the two principal axes at the cross section are not the same The convergence factor beta is proposed to make residuals converge and rapidly decrease In the proposed procedure, beta times the estimated compensatory weight may be attached to the rotor Beta may be scalar or vector and its magnitude must be smaller than unity The effectiveness of beta as a convergence factor is theoretically verified This concept of the convergence factor in a balancing process is analogous to that of stabilization of feedback loops in automatic control systems and that of a convergence factor in iterative methods of numerical calculation (Author)

A79-31486 # Engineer s handbook of flight and radio equip ment of airplanes and helicopters (Spravochnik inzhenera po aviatsionnomu i radioelektronnomu oborudovaniiu samoletov i verto letov) V G Aleksandrov B I Bazanov A V Maiorov N I Potiukov and S S Sukhanov Moscow Izdatel'stvo Transport 1978 408 p 42 refs In Russian

The handbook provides essential information on the operation, monitoring, and repair of the flight equipment and electronics of aircraft Technical data on flight control instruments life support systems autopilots navigation equipment electronic circuits air craft loading, and cabin sealing are given A section on safety of maintenance operations is included P T H

A79-31491 # Flight dynamics /2nd revised and enlarged edition/ (Dinamika poleta /2nd revised and enlarged edition/) A M Mkhitarian, P S Laznuk V S Maksimov, R A Mezhlumian L G Totiashvili, and A G Baskakova Moscow, Izdatel'stvo Mashinostroe nie 1978 424 p 90 refs In Russian

This is a textbook on flight dynamics, covering the equations of motion of an aircraft, aircraft trajectory calculations horizontal flight, climb descent range and duration of flight curvilinear flight, takeoff and landing, longitudinal static stability and controllability lateral static stability and controllability balancing of forces and moments in steady curved flight, the general problem of stability control, longitudinal disturbed motion, lateral disturbed motion stability and control with automatic instruments and effect of elastic strains of the structure on stability and control Special sections are devoted to stability and control in emergency situations, flight dynamics in a disturbed atmosphere and special characteristics of high angle of attack flight P T H

A79 31564 Construction and calibration of pitot static systems (Konstruktion und Eichung der Pitotstatikanlagen) A Dehm (Bundesamt für Wehrtechnik und Beschaffung, Munich, West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumfor-schung,* vol 3 Jan Feb 1979 p 14-23 16 refs In German

The introduction of automatic altitude reports in connection with a surveillance of the separation levels of aircraft makes it necessary to examine the performance of pitot static systems Error calculations have shown that conditions at flight altitude of 30,000 ft are critical The reported investigation has the objective to show constructive solutions for pitot static systems used for altitude reports, taking into account the regulations which have to be satisfied by suitable pitot static systems Attention is given to similarity relations the selection of the equipment, design and construction details, aspects of error correction questions of calibration and design and testing regulations G R

A79-31565 The consideration of the effect of winds in the mechanics-of-flight equations (Berücksichtigung des Windeinflusses in den flugmechanischen Gleichungen) P Krauspe and J Klenner (Braunschweig Technische Universitat, Braunschweig West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumfor schung,* vol 3 Jan Feb 1979 p 23 28 9 refs In German

The flight characteristics of an aircraft can be significantly disturbed as a result of air motions It has been found during the last few years that low frequency changes in the wind characteristics can produce considerable hazards for flight safety and must, therefore also be taken into consideration A method reported by Brockhaus

and Wust (1977) concerning the open loop compensation of wind shear effects in low level flight appears particularly well suited for such a consideration A description is presented of an approach which simplifies the problems related to an implementation of the considered method The approach makes use of the definition of a direct Eulerian angle sequence between the aerodynamical and the air axis system G R

A79 31612 # Flying the Avro Arrow J Woodman (Lockheed Aircraft Corporation of Canada, Ltd , Ottawa, Canada) *(Canadian Aeronautics and Space Institute, Flight Test Symposium, Winnipeg, Canada May 16, 1978) Canadian Aeronautics and Space Journal,* vol 25 1st Quarter 1979, p 1 16

The Avro Arrow program, cancelled in 1959 is discussed Design features of the Arrow Mk 1 aircraft are described including such parameters as maximum takeoff weight 69,000 lb, maximum speed Mach 2 and maximum angle of attack 15 deg The flight test program phases are taken into account, noting that the last four were slated for Air Force testing and evaluation The data acquistion and handling system is considered, indicating that it consisted of an airborne multichannel recorder, a phono panel, an oscillograph an airborne radio telemetry link and a mobile telemetry receiving station Also considered are the performance specifications for the Arrow Mk 2 under ICAO standard atmospheric conditions A A

A79-31613 # A NASA initiative for general aviation - The general aviation airfoil design and analysis service G M Gregorek K D Korkan, and R J Freuler (Ohio State University, Columbus Ohio) *(Canadian Aeronautics and Space Institute, Annual General Meeting, Winnipeg, Canada, May 16, 17, 1978) Canadian Aeronautics and Space Journal,* vol 25 1st Quarter 1979 p 34-42 7 refs

The NASA initiated General Aviation/Airfoil Design and Analysis Center (GA/ADAC) at the Ohio State University s Aero Astro Research Laboratory (AARL) is discussed Capabilities are considered, inclucing the AARL computer system used extensively in on line, real time, interactive data acquisition/reduction, and the library of computer codes developed for and by NASA Service experience is taken into account, noting that (1) expert help may be drawn in from AARL as required (2) as senior GA/ADAC staff are assigned part time to the NASA sponsored part of the service their efforts may be expanded to support industry sponsors as necessary, and (3) the interest in new airfoils is quite high with groups such as the Experimental Aircraft Association, thus some mechanism must be set up to serve this segment of aviation A A

A79-31691 # Estimate of the noise immunity of a double FSK modem in communications channels with fading (K otsenke pomekhoustoichivosti modema s DFRM 2 v kanalakh sviazi s zamiraniiami) V K Reshemkin and O I Shchaev *Radiotekhnika,* vol 34 Jan 1979, p 66-69 In Russian

Analysis of the noise rejection characteristics of a dual FSK modem in channels with fast and slow signal fading events Error probabilities are given for various signal fading rates and system base values Test comparisons are made with an FM modem for a simulated short wave channel T M

A79-31716 Experimental investigation of the endurance of airplane fin sections in acoustic loading L E Matokhniuk, Iu M Golovanev V G Samokhin I A Kashchuk B K Karpenko, and T Z Elezova (Akademiia Nauk Ukrainskoi SSR, Institut Problem Prochnosti Kiev Ukrainian SSR) *(Problemy Prochnostr* July 1978 p 117-120) *Strength of Materials* vol 10 no 7 Mar 1979, p 860 863 Translation

The acoustic endurance of rudder fin sections differing in the arrangement of the ribs was studied at acoustic loads between 142 and 150 dB, varying the frequency from 120 to 290 Hz Symmetric attachment of the ribs to the skin is shown to greatly improve acoustic resistance V P

A79 31888 Automating prevailing visibility J T Bradley M Lefkowitz and R Lewis (NOAA National Weather Service Sterling, Va) In Conference on Weather Forecasting and Analysis and Aviation Meteorology, Silver Spring, Md , October 16 19 1978 Preprints Boston Mass , American Meteorological Society, 1978, p 332 338 9 refs

Techniques used for determining averages and data sampling rates for sensor prevailing visibility (PV) are described While these averages are developed using a specific sensor type the techniques are generalized and would apply to most visibility sensors Attention is given to the results of tests at Patrick Henry International Airport Newport News, Virginia and to a comparison of these results with earlier data from Dulles International Airport, Chantilly Virginia It is shown that the videograph, although having limited sampling volume (13 cu ft) samples a relatively large volume compared to other types of visibility sensors currently on the market The observed averaging times of 6 10 min generate the best compromise between smoothing to remove short-term sampling or temporal fluctuations and speed to respond to the general trend of actual visibilities Sensor derived PV has only fair agreement with human visibility at both airports most probably due to human limitations and differences between human and automated concepts of observing S D

A79 31901 # Modeling helicopter flight dynamics (Modelirovanie dinamiki vertoleta v polete) L M Berestov Moscow Izdatel stvo Mashinostroenie, 1978 159 p 16 refs In Russian

Principles of simulating helicopter flight on the basis of a model of the helicopter as a control object are developed Equations for the coefficients of the equations of motion of a helicopter are derived Simplified equations for longitudinal motion are obtained, and expressions for the zeros and poles are derived A similar analysis for lateral motion is also given Principles of airborne simulation are then developed for the case when the number of control channels of the airborne laboratory equals the number of degrees of freedom and when it is less P T H

A79-31902 # - Aviation centrifugal pump equipment /2nd revised and enlarged edition/ (Aviatsionnye tsentrobezhnye nasosnye agregaty /2nd revised and enlarged edition/) A Iu Polinovskii and L B Leshchiner Moscow Izdatel'stvo Mashinostroenie 1978 216 p 28 refs In Russian

The book sets forth basic design principles for aircraft centrifugal pumps The discussion covers pumps driven by electric motors pumps driven by air turbines pumps with hydraulic drive, and pumps with mechanical drive from the aircraft engine Considerations for the rational choice of pump type are discussed Special attention is devoted to the high altitude characteristics of pumps, overload capacity of pumps operation of pumps under conditions of weightlessness, and sealing methods for aircraft pumps P T H

A79-31911 Prospects for reducing the fuel consumption of civil aircraft G G Pope (Royal Aircraft Establishment Farnborough, Hants , England) In Energy and aerospace Proceedings of the Anglo/American Conference London England, December 5-7 1978 London Royal Aeronautical Society, 1979 21 p 10 refs

An outline is provided of technological advances that will contribute to the reduction of fuel consumption Attention is concentrated mainly on advances being made in the UK The emphasis is on developments that can be exploited in the generation of aircraft which will succeed the more recent of the transport aircraft types now in service and those which will reach the airlines in the early 1980s Advances in powerplants are examined along with developments in aerodynamics, taking into account advances in design techniques, experimental facilities, wing tip design drag reduction and laminar flow control Attention is also given to materials and structures, active control technology and operational considerations G R

A79-31912 * # The NASA Aircraft Energy Efficiency program J M Klineberg (NASA Washington D C) In Energy and

aerospace, Proceedings of the Anglo/American Conference, London England, December 5-7, 1978 London, Royal Aeronautical Society 1979 19 p

A review is provided of the goals, objectives, and recent progress in each of six aircraft energy efficiency programs aimed at improved propulsive, aerodynamic and structural efficiency for future transport aircraft Attention is given to engine component improvement, an energy efficient turbofan engine advanced turboprops revolutionary gains in aerodynamic efficiency for aircraft of the late 1990s laminar flow control, and composite primary aircraft structures G R

A79 31913 # Aviation fuels from coal J Gibson (National Coal Board London England) In Energy and aerospace Proceedings of the Anglo/American Conference London England December 5 7, 1978 London Royal Aeronautical Society 1979 16 p

Although the ultimate aviation fuel may prove to be liquid hydrogen produced from water by electrolysis using nuclear power, there are powerful arguments to continue to use hydrocarbon fuels and as much as possible of the infrastructure associated with them In effect, the objective must be to bridge the gap until reliance can shift to nuclear based fuel and that is still far off Attention is given to the world fuel reserves, the demand for aviation fuel, the principles of coal liquefaction conventional and unconventional aviation fuels from coal coal liquefaction processes and possible alternative strategies The current status and potential for aviation fuels from coal are considered and the UK program on coal liquefaction is discussed G R

A79-31945 # The cost situation in the material maintenance of civil aviation aircraft (Die Kostensituation in der Materialerhaltung ziviler Luftfahrzeuge) H Gröger (Deutsche Lufthansa AG Hamburg, West Germany) In Material maintenance costs for flying systems in the utilization phase Symposium, Cologne, West Germany March 29, 1979 Reports. Cologne, Deutsche Gesellschaft für Luft und Raumfahrt, 1979 18 p In German (DGLR 79 014)

In the present paper, an attempt is made to depict the cost situation in material maintenance on the basis of some examples typical for European airlines Specifically the Lufthansa maintenance routines for long-haul, medium haul, and short haul aircraft are diagrammed, along with the corresponding man/hour data V P

A79-31946 # Adaptation of the EMSG 2 to military aircraft, using the Alpha Jet as an example (Die Adaption des EMSG 2 für militärische Luftfahrzeuge am Beispiel des Alpha Jet) G Frank (Dornier GmbH Germering West Germany) In Material maintenance costs for flying systems in the utilization phase Symposium, Cologne West Germany, March 29 1979, Reports Cologne, Deutsche Gesellschaft fur Luft und Raumfahrt, 1979 15 p In German (DGLR 79 019)

The military engineering, and economic demands placed on the Alpha Jet weapon system require the manufacturer to submit an economical material maintenance concept The present paper deals with the adaptation of an MSG (Maintenance System Guide) developed from economical considerations by the civil aviation to the Alpha Jet weapon system V P

A79 31947 # ROD' /Reliability on Demand/ as an aid in aircraft maintenance ('ROD' /Reliability On Demand/ als Hilfsmittel zur Luftfahrzeug Wartung) K Schurger (Deutsche Lufthansa AG, Hamburg, West Germany) In Material maintenance costs for flying systems in the utilization phase, Symposium Cologne, West Germany, March 29, 1979, Reports Cologne, Deutsche Gesellschaft fur Luft und Raumfahrt, 1979 4 p In German (DGLR 79-020)

ROD is a computer aided information and control system that can be used effectively for trouble shooting in various situations In the present paper, experience obtained with ROD over a period of one and a half years in the field of aircraft maintenance is reviewed The conclusion is that ROD increases aircraft reliability while reducing maintenance costs V P

A79 31948 # Determination of inspection intervals for aircraft structures on the basis of fracture mechanics (Ermittlung von Inspektionsintervallen fur Flugzeugstrukturen mit Hilfe der Bruchmechanik) W Geier (Messerschmitt Bolkow Blohm GmbH, Munich, West Germany) In Material maintenance costs for flying systems in the utilization phase, Symposium Cologne, West Germany March 29, 1979, Reports Cologne, Deutsche Gesellschaft fur Luft und Raumfahrt, 1979 11 p In German (DGLR 79 021)

In the present paper, the Tornado Weapon System is used as an example to show how fracture mechanics can be applied to the determination of structure inspection requirements In this approach engineering judgement is replaced by a computational procedure The respective rating system is diagrammed and the recommended inspection intervals (flight hours) are established as a function of the combined rating Finally, the inspection requirements are analyzed from the viewpoint of two different design philosophies V P

A79-31949 # New test concepts and their influence on maintenance (Neue Prufkonzepte und ihre Auswirkungen auf die Instandhaltung) M Weyerer (Messerschmitt Bolkow Blohm GmbH Ottobrunn West Germany) In Material maintenance costs for flying systems in the utilization phase, Symposium Cologne, West Germany, March 29, 1979 Reports Cologne Deutsche Gesellschaft fur Luft- und Raumfahrt, 1979 22 p In German (DGLR 79 022)

The two criteria which define the state are such operational damages as wear and fatigue, and corrosion and aging of components both of which depend on service time In the present paper these criteria are used as a basis to discuss the factors which influence the development of a test concept the integration of test systems into the framework of the material preservation (maintenance) concept the effects of the test concept on maintenance and some problems associated with the automation of test concepts For illustration the analysis is carried out for the Tornado Weapon System V P

A79-31957 * Static evaluation of surface coatings for compliant gas bearings in an oxidizing atmosphere to 650 C B Bhushan and S Gray (Mechanical Technology Inc, Latham N Y) In Metallurgical coatings 1978, Proceedings of the Fifth International Conference, San Francisco, Calif, April 3 7, 1978 Volume 1 Lausanne Elsevier Sequoia S A 1978, p 313 331 17 refs Contract No NAS3 19427

Hard wear resistant coatings and soft low shear strength coatings were developed for an air lubricated compliant journal bearing for a future automotive gas turbine engine The coatings were expected to function in either 540 or 650 C ambient Soft lubricant coatings were generally limited in temperature Therefore emphasis was on the hard wear resistant coatings The coating materials covered were TiC, B4C Cr3C2 WC, SiC, CrB2, TiB2 Cr2O3 Al2O3 Si3N4 Tribaloy 800 CaF2 CaF2 BaF2 eutectic, Ni Co silver CdO-graphite and proprietary compounds The coatings on test coupons were subjected to static oven screening tests The test consisted of exposure of material samples in an oven for 300 h at the maximum temperature (540 or 650 C) and ten temperature cycles from room temperature to the maximum service temperature On the basis of the specimen examinations the following coatings were recommended for future wear tests TiC (sputtered), Cr2O3 (sputtered) Si3N4 (sputtered) CdO and graphite (fused) Kaman DES (a proprietary coating), CrB2 (plasma sprayed) Cr3C2 (detonation gun) and NASA PS 106 (plasma sprayed) (Author)

A79 32025 # Gas flow in nozzles (Techeniia gaza v soplakh) U G Pirumov and G S Rosliakov Moscow Izdatel'stvo Moskovskogo Universiteta 1978 351 p 195 refs In Russian

The general theory of gas flow in nozzles is presented and some of the current analytical and numerical methods of investigating

these flows are studied in detail The method of characteristics and shock capturing techniques for plane axisymmetric, and three dimensional flows are considered along with methods for solving the inverse problem for a nozzle Considerable attention is devoted to asymptotic methods such as the method of sources and sinks expansion in terms of the stream function, and the perturbation method Questions in the design of subsonic and supersonic jet engine nozzles are taken up Engineering methods for calculating flows with reactions are presented including flows with nonequilibri um chemical reactions flows with oscillating relaxation two phase flows, and flows in the presence of a magnetic field Some consideration is also given to the characteristics and design of annular nozzles and swirling nozzle flows P T H

A79 32027 # **Mathematical model and stability of a hydrau lic servodrive with a fluidic throttle governor (Matematicheskaia model' i ustoichivost' sledíashchego gidroprivoda so struino drossel'nym regulirovaniem)** A I Bazhenov *Aviatsionnaia Tekh nika,* vol 21 no 4 1978 p 11 15 In Russian

In the present paper the hydrodynamic action on a fluidic tube is analyzed for various modes of servodrive operation The block diagram of a hydraulic servodrive with a fluidic throttle governor including the feedback from the hydrodynamic action to the fluidic tube is given and discussed The method of logarithmic frequency characteristics involving the construction of a stability interface, is applied to the solution of the stability problem and the problem of self-oscillations in the system V P

A79-32032 # **Analog simulation and its defining similarity criteria in the analysis of supersonic flows past wings (Analogovoe modelirovanie pri izuchenii obtekaniia kryla v sverkhzvukovom potoke i ego opredeliaiushchie kriterii analogi)** R I Vinogradov *Aviatsionnaia Tekhnika,* vol 21, no 4, 1978 p 43-48 5 refs In Russian

A79-32036 # **A basic problem in the analytical designing of aircraft gas turbine engines I (Osnovnaia zadacha analiticheskogo proektirovaniia aviatsionnykh gazoturbinnykh dvigatelei I)** Iu V Kozhevnikov V O Borovik V S Ivanov V A Talyzin I N Agliullin, and Iu V Meluzov *Aviatsionnaia Tekhnika,* vol 21, no 4 1978, p 68 74 In Russian

It is proposed to separate the problem of designing gas turbine engines into a number of marginal successively solvable problems The problem of modeling and optimizing the thermogasdynamic parameters of the engine is termed the basic problem A solution of the basic problem yields a set of initial data for designing the elements of a gas turbine engine The basic problem of analytical design is formulated with allowance for the influence of random factors and the multimode nature of engine operation V P

A79-32038 # **Selecting the geometrical parameters and loca tion of the nose flap at the wing root profile of a swept wing on the basis of wind tunnel data II (K vyboru geometricheskikh parametrov i polozheniia nosovogo shchitka na kornevom profile strelovidnogo kryla po dannym trubnykh ispytanii II)** A I Matiazh V A Sterlin V A Popov, V V Isaev, and G A Cheremukhin *Aviatsionnaia Tekhnika,* vol 21 no 4 1978 p 81 87 5 refs In Russian

A79 32040 # **Modeling the sensitivity of a linear system to a decrease in its order by the method of infinitesimal transformation in the problem of yaw control (O modelirovanii chuvstvitel'nosti lineinoi sistemy k ponizheniiu ee poriadka metodom infinitezi- mal'nogo preobrazovaniia v zadache upravleniia dvizheniem ryskan'ia)** V G Pavlov *Aviatsionnaia Tekhnika* vol 21, no 4 1978 p 94 98 In Russian

The method proposed for solving the problem of sensitivity to a decrease in order of a linear system is based on the use of certain concepts of the theory of continuous groups The idea is to imbed the initial process into a continuous set obtained by transformation of the nominal set and to use a lower order system as the initial one The set of processes corresponding to higher order systems is obtained by transformation of the initial system The method is applied to the problem of yaw control It is shown that sensitivity is well modeled by a continuous transformation group defined by the Lie algebra of three basis operators V P

A79-32041 # **The problem of empennage snap through (K zadache o proshchelkivanii operenila)** V A Pavlov and S K Chernikov *Aviatsionnaia Tekhnika,* vol 21 no 4 1978 p 99 104 8 refs In Russian

A mathematical model in the form of a system of nonlinear integrodifferential equations is derived for aircraft rudder and elevator units A solution of this system of equations obtained by the method of successive loads is shown to adequately predict the conditions for rudder and elevator failure V P

A79-32042 # **Electrification of woven and film materials (Elektrizatsiia tkannykh i plenochnykh materialov)** B G Popov V N Baklygin, and I I Chistiakov *Aviatsionnaia Tekhnika* vol 21 no 4, 1978 p 105 111 In Russian

Attention is given to the process of electric charge accumulation on woven or film type materials contacting with similar materials or with metal surfaces The problem is examined from the viewpoint of minimizing accidental ignition of composite materials by electric sparks in the oxygen atmospheres of aerospace vehicles Data from analytical and experimental studies are provided which relate the charge accumulating at the surface with the properties of the material and the bond strength of contact with another surface T M

A79-32046 # **Creep calculation for thin walled structures operating under unsteady heating and loading conditions (K raschetu na polzuchest' tonkostennykh konstruktsii pri nestatsionarnom nagreve i nagruzhenii)** V G Shataev, Iu A Kashfraziev, and A G Samartsev *Aviatsionnaia Tekhnika* vol 21 no 4 1978 p 130 132 In Russian

A method of designing for strength and rigidity is proposed for aircraft structures (wings, fuselages) in unsteady creep operating under time variable temperatures and loads It is assumed that the cross sections of the structure do not deform, that the skin operates only in shear and the longitudinal members in tension and compression Creep calculation is carried out in time steps The solution obtained is ALGOL programmed for the M 222 computer V P

A79-32047 # **Calculation of wings of variable sweep (K raschetu kryl'ev peremennoi strelovidnosti)** N A Shelomov and N A Gorozhankin *Aviatsionnaia Tekhnika* vol 21, no 4, 1978 p 133-141 In Russian

A method is proposed for calculating wings of variable sweep on the basis of a model of a combinational system, in differential formulation The analysis is carried out for (partitions in the form of) bevelled conical and cylindrical membrane shells located between wing ribs, making use of Obraztsov and Onanov s (1973) equilibrium equations of such shells V P

A79-32051 # **Effective rigidity of a thin walled beam (Ob effektivnoi zhestkosti tonkostennoi balki)** V A Pavlov *Avia- tsionnaia Tekhnika* vol 21 no 4 1978 p 151 155 In Russian

The analysis deals with the problem of determining a certain effective flexural rigidity in zones of constrained plane dislocations (at cutouts etc), where the law of a plane percentage elongation distribution no longer holds and where formal determination of rigidity is not possible Expressions for determining the effective flexural rigidity of a thin walled aircraft element (rudder) are derived V P

A79 32052 # **Application of a factorial interpolation method to the analytical designing of aircraft landing gears (Primene- nie faktornogo interpoliatsionnogo metoda v zadache analiticheskogo proektirovaniia posadochnogo ustroistva letatel'nogo apparata)** A

V Svilin *Aviatsionnaia Tekhnika*, vol 21 no 4, 1978, p 155 158 In Russian

The method proposed in the present paper for solving the synthesis problem for landing gears provides a means of calculating the probability of finding the performance indices of a landing gear within a prescribed region from the mathematical expectations and dispersions of the performance indices These mathematical expecta tions and dispersions are calculated by an economical factorial interpolation method which yields the statistical characteristics within any accuracy desired V P

A79 32054 # Flow past a small aspect ratio delta wing with vortex filament breakdown (Obtekanie treugol'nogo kryla malogo udlinenia s 'razrusheniem' vikhrevogo zhguta) G A Cheremukhin E A Truneva and E Ia Pivkin *Aviatsionnaia Tekhnika* vol 21, no 4, 1978, p 162 167 9 refs In Russian

In the present paper the influence of changes in the vortex structure of the near wake on the boundary layer flow and dyna mic characteristics of a small aspect ratio delta wing is analyzed The relationship between the state of vortex filament and the flow at the wing surface is examined It is shown that vortex breakdown affects appreciably both the pressure distribution and the aerodynamic behavior of the wing V P

A79-32085 # Stability and unbalance response of centrally preloaded rotors mounted in journal and squeeze film bearings E J Hahn (New South Wales University Kensington Australia) *ASME, Transactions Journal of Lubrication Technology*, vol 101 Apr 1979, p 120 128 14 refs Research supported by the Alexander von Humboldt Stiftung and Australian Research Grants Committee

The unbalance response and stability of centrally preloaded symmetric rigid rotors are investigated Steady state solutions for unbalance transmissibilities, orbit eccentricity radii and stability are presented for rotors running in hydrodynamic journal bearings and in rolling element bearings which are supported in squeeze film bearings The Ocvirk and Warner approximations are used to evaluate the fluid forces, rendering the data applicable to any length/diameter ratio Both pressurized (2 pi film) and unpressurized (pi film) oil supply are considered Pressurization has a far reaching influence on the steady state behavior of both journal and squeeze film bearings For unpressurized bearings conditions of multistable operation and for stability are depicted The error involved in predicting vertical bearing behavior by assuming an equivalent unidirectional load equal to the unbalance load is demonstrated For pressurized bearings multistable operation is eliminated, but both squeeze film and journal bearings are unstable for most length/diameter ratios in the absence of external radial stiffness The stabilizing effect of superimposed external radial stiffness on pressurized bearings is clearly demonstrated While pressurized journal bearings can run stably, they are less suited than pressurized squeeze film bearings for vibration isolation (Author)

A79-32158 Reconstructed flight control sensor signals via Luenberger observers E Y Shapiro F L Schenk and H E Decarli (Lockheed California Co Burbank Calif) *IEEE Transactions on Aerospace and Electronic Systems* vol AES 15 Mar 1979 p 245 252 8 refs

The feasibility of providing flight control systems with software managed redundancy is investigated It is shown that sufficient information can be extracted from aircraft attitude sensors to allow analytic reconstruction of the stability augmentation system (SAS) sensor signals in the event of SAS sensor failures The sensor signal reconstruction is performed in a deterministic setting by using a Luenberger observer A simple and efficient design procedure is presented based on Gopinath s work As an illustrative example the proposed sensor signal reconstruction technique is exercised on the L 1011 aircraft lateral axis rigid body simulation It is shown that with an accurate airframe model perfect reconstruction is feasible In addition, it is also shown via simulation results that with imperfect knowledge of the airframe model (based on standard wind tunnel data), the proposed reconstruction is accurate enough to have a negligible impact on the overall aircraft performance (Author)

A79-32164 Heading and speed errors for x, y tracking filters F R Castella (Johns Hopkins University, Laurel, Md) *IEEE Transactions on Aerospace and Electronic Systems*, vol AES 15, Mar 1979 p 284-287 5 refs

Heading and speed errors are analytically determined for nonmaneuvering targets at the output of an x y tracking filter which processes range and bearing measurements from a radar sensor in a track while scan (TWS) operation These errors are shown to depend upon target range and speed, the angle between the radius and velocity vectors, sensor accuracies, and tracking filter parameters Depending upon the tracking filter implementation these errors may also be a function of target bearing (Author)

A79-32190 High power UHF slide screw tuner for antenna breakdown measurements C D Lunden and L L Oh (Boeing Aerospace Co Seattle Wash) *Microwave Journal* vol 22, Apr 1979, p 84 85 92

A sensitive voltage breakdown detector system, using reflected power that can instantly shut off the transmitter the moment breakdown occurs in the tested unit, is demonstrated The key to successful use of the sensitivity is shown to be a low SWR tuner which sets the pre-breakdown reflected power low enough to allow a breakdown triggered decision to be made by logic circuitry A slide screw tuner based on the HP 805A slab line geometry was found to meet this requirement for aircraft UHF transmitting antenna application A A

A79 32230 # Aviation safety - Facts and fiction J R Colwell (Guild of Air Pilots and Air Navigators, Australia) *Navigation* (Australia) vol 5, Dec 1978, p 633 642 8 refs

Aviation in Australia is compared with other countries, particu larly the U S , with emphasis on safety matters A figure is used to measure major airlines in terms of aircraft numbers widebody, normal jet as well as turboprop and revenue passenger kilometers, showing that the Australian domestic airlines in total have less capacity than any of the eleven U S trunk carriers Safety statistics are examined indicating that the U S has the best record, with Canada and Australia being second and third, respectively Domestic airline fares in Australia are compared with those in the U S , showing that in Australia they are almost twice as expensive Various U S and Australian airports are considered in terms of operation efficiency noting that the first are superior to the latter Suggestions for upgrading the Sydney airport are presented A A

A79 32231 # The new P3C Orion aircraft with the RAAF P Hodgson (Royal Australian Air Force Glenbrook, New Zealand) *Navigation* (Australia) vol 5, Dec 1978, p 694 704

The P3C Orion aircraft, designed for maritime surveillance anti submarine warfare, and search and rescue operations, is discussed Aircraft performance is taken into account noting that maximum endurance is 16 hours with cruise speed and maximum range being at about 360 kts TAS and 5000 nms, respectively The functions of the data processing system, based on the operation of a central digital data computer (the ASQ 114) are noted including control ling symbology on the tactical and auxiliary displays and recording flight data for use later in flight as well as in post flight analysis Computer hardware and programs are considered as are the various computer displays Navigation systems are described A A

A79 32240 NASA says FAA understates air crash risk *Science* vol 204 Apr 27, 1979, p 387 388

According to a draft reported by NASA the number of near crashes of aircraft of busy airports may be 12 times higher than FAA estimates show The NASA report estimates a near midair collision rate of 24 3 per million operations in terminally controlled areas, as opposed to the FAA official figure of two per million operations The NASA estimate is based on confidential reports, while reports filed with the FAA render participants subject to prosecution The effect of the NASA study on the FAA proposal to extend ground control regulation of airspace is discussed J M B

A79 32241 Up and away with QSRA *Aviation Engineering and Maintenance,* vol 3, Mar 1979 p 16 19

NASA's QSRA experimental aircraft, regarded as the quietest jet ever built and designed to demonstrate new forms of lift, is discussed The main features of the wing are considered, noting that the fixed leading edge flaps are blown by a mixed flow boundary layer control system with the trailing edge on either side of the centerline consisting of two upper surface blowing flaps, a double-slotted flap, and a drooped, blown aileron The Boundary Layer Control and the Upper Surface Blowing techniques are described, indicating that the first is applied to the wing leading edge to delay wing stall to higher angles of attack, and the latter is used for converting a large portion of thrust to lift Lift capability is examined, showing that the QSRA can safely operate at a lift coefficient of 5 5 while maintaining speed, angle of attack, maneuver and go around climb margins Also examined are approach angle and acoustic performance Current status and future plans are reviewed A A

A79-32242 Landing gear overhaul survey *Aviation Engineering and Maintenance,* vol 3, Mar 1979 p 24-26, 28, 30

A survey of the landing gear overhaul market is presented together with a list of organizations which perform landing gear overhaul on standard and wide body turboprop and turbofan transport aircraft Market changes are taken into account, noting that while in prior years the majority of landing gear refurbished has been from standard body aircraft, beginning this year wide body landing gear will make up a larger percentage of the total overhaul market The North American market is considered, indicating that the market value of the overhaul should continue its present upward trend increasing at a rate of 18% in 1980 Also considered is landing gear research A A

A79 32243 Permanent magnet generators - Next genera tion in VSCF power systems *Aviation Engineering and Maintenance,* vol 3, Mar 1979, p 33-35

Variable speed constant frequency (VSCF) generators are reviewed, with emphasis placed on a new system, using rare earth SmCo magnets, currently under development at Air Force's Propul sion Lab Advantages of the system over its earlier counterparts are noted, as are such qualities of the rare earth magnets as extreme resistance to demagnetization, and high magnetic energy storage capability Projected testings are considered indicating that after about 500 hours of endurance testing, eight more systems will be manufactured for flight testing on the A 10 A A

A79 32244 KC 135s get 'heads up' research *Aviation Engineering and Maintenance,* vol 3, Mar 1979 p 43 45

A new HUD (Head-Up-Display) system developed at the Air Force's Flight Dynamics Laboratory in conjunction with Sunstrand Corp is described The system allows boom operators on tankers to focus their attention on the refueling operation, while keeping tabs on vital flight data simultaneously An electromechanical format is utilized to generate symbology through a set of projection lamps which shine through a stencil of filter, with a series of images etched onto the stencil Each of the 650 KC 135 airplanes operated by the Air Force may potentially be retrofitted with the new boom HUD if tests conducted at Travis AFB, California, prove the viability of the design A A

A79-32246 The EA 6B Weapon Systems trainer M Shohat *Military Electronics/Countermeasures,* vol 5, Apr 1979 p 50 52 55, 79

The EA 6B Weapon Systems trainer largest and most complex simulator procured by the Navy, is described The multicomputer architecture is considered noting that the failure of one of the four SEL 32/55 computers sharing a fourway memory does not terminate simulator availability The Electronic Warfare (EW) System is taken into account, indicating that the signal processing capabili ties of the EW simulator are known to be in consonance with dense electromagnetic environments up to 512 emitters per mission with 64 active emitters on line The Digital Radar Landmass Simulators subsystem simulating the EA 6B's APQ 129 search radar is exam-ined as is the Computer Generated Imagery system A A

STAR ENTRIES

N79-19991*# National Aeronautics and Space Administration Langley Research Center Hampton Va
TRANSONIC ASSESSMENT OF TWO DIMENSIONAL WIND TUNNEL WALL INTERFERENCE USING MEASURED WALL PRESSURES
William B Kemp Jr *In its* Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 473 486 refs

Avail NTIS HC A14/MF A01 CSCL 14B

A method is described for assessing wall interference in two dimensional wind tunnels with better realism and accuracy than is achieved with methods based on classical wall interference theory Measured pressure distributions were imposed as boundary conditions on a nonlinear transonic form of the potential equation to obtain an accurate computational reproduction of the actual tunnel flow Wall induced velocity perturbations were then extracted to yield both corrections to the tunnel test conditions and a measure of the adequacy of these corrections to account for tunnel interference Application of the method to a transonic tunnel with variable porosity walls is illustrated J A M

N79-19992*# Calspan Corp Buffalo N Y
RESEARCH ON SELF-CORRECTING WIND TUNNELS
R J Vidal and J C Erickson Jr *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 487-498 refs
(Contracts N00014-72-C-0102 N00014-77-C 0052 F40600 76-C 0011)
Avail NTIS HC A14/MF A01 CSCL 14B

The Calspan self-correcting wind tunnel is a two dimensional facility in which the flow field in the vicinity of the walls is actively controlled and a theoretical evaluation is used in conjunction with flow field measurements to confirm that wall interference was minimized The facility is described and the results of experiments with a 6 percent blockage model are presented to show that iterative application of wall control effectively eliminates the interference Experiments were performed at conditions where the flow at the walls was supercritical and a new operating procedure is described for these conditions The results of an analysis of the flow in the auxiliary suction system and test ion illustrate the tradeoffs available in the design of self-correcting wind tunnel test sections and in model sizing for such tunnels J A M

N79-19993*# National Aeronautics and Space Administration Langley Research Center Hampton Va
ANALYTICAL DESIGN OF A CONTOURED WIND-TUNNEL LINER FOR SUPERCRITICAL TESTING
Perry A Newman and E Clay Anderson *In its* Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 499-509 refs

(Contract NAS1-14517)
Avail NTIS HC A14/MF A01 CSCL 14B

The present analytical design procedure is being developed in order to determine the shape of a contoured nonporous wind tunnel liner for use in the Ames 12-foot pressure wind tunnel test of a large chord laminar flow control swept wing panel which has a supercritical airfoil section This procedure is applicable to the two dimensional streamlined tunnel problem wall shape with that found experimentally J A M

N79-19994*# Ohio State Univ Columbus Aeronautical and Astronautical Research Lab
EVALUATION OF INTERFERENCE IN THE OSU 6 IN BY 22 IN TRANSONIC AIRFOIL TUNNEL
John D Lee *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 511-525 ref

Avail NTIS HC A14/MF A01 CSCL 14B

Interference in a 6 in by 22 in two dimensional wind tunnel was evaluated at Mach numbers up to 1 06 by comparing pressure distributions from airfoil models of differing size Models of the NACA 0012 profile having chords of 76 152 and 305 mm were used in one phase of the evaluation program and models of a supercritical profile having chords of 76 and 152 mm were used in another The confinement interference was documented i e blockage downwash and streamline curvature all of which are quite small on a model having a chord of 152 mm and which can for most applications be ignored Specifically the corrections were lumped into an attack angle adjustment of -0 16 degrees per unit lift coefficient on a 152 mm model J A M

N79-19995*# Notre Dame Univ Ind
VISUALIZATION OF THE SEPARATION AND SUBSEQUENT TRANSITION NEAR THE LEADING EDGE OF AIRFOILS

Anthony V Arena and Thomas J Mueller *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 527-538 refs
(Grant NsG-1419)
Avail NTIS HC A14/MF A01 CSCL 01A

A visual study was performed using the low speed smoke wind tunnels with the objective of obtaining a better understanding of the structure of leading edge separation bubbles on airfoils The location of separation transition and reattachment for a cylindrical nose constant-thickness airfoil model were obtained from smoke photographs and surface oil flow techniques These data together with static pressure distributions along the leading edge and upper surface of the model produced the influence of Reynolds number angle of attack and trailing edge flap angle on the size and characteristics of the bubble Additional visual insight into the unsteady nature of the separation bubble was provided by high speed 16 mm movies The 8 mm color movies taken of the surface oil flow supported the findings of the high speed movies and clearly showed the formation of a scalloped spanwise separation line at the higher Reynolds number J.A M

N79-19997*# National Aeronautics and Space Administration Langley Research Center Hampton Va
APPLICATION OF THE LASER VELOCIMETER TO AIRFOIL RESEARCH
Danny R Hoad *In its* Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 559-570 refs

Avail NTIS HC A14/MF A01 CSCL 20E

A laser velocimeter (LV) was installed in the Langley V/STOL tunnel to measure the velocity field about a wing with a NACA 0012 airfoil section These measurements were compared at low angle of attack with a two dimensional viscous flow prediction program The velocity field over the wing in a fully stalled condition was also measured by the LV The unique ability of the LV to measure absolute flow magnitude and direction without prior knowledge of general flow direction was demonstrated in the complex separated reverse flows near the wing upper surface at the high angle of attack The general characteristics of the flow field over the stalled wing were substantiated by a vapor screen flow visualization technique J A M

N79-19999*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
HOLOGRAPHY AND LDV TECHNIQUES THEIR STATUS AND USE IN AIRFOIL RESEARCH
D A Johnson and W D Bachalo (Spectron Development Labs Inc) *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 589 599 refs
Avail NTIS HC A14/MF A01 CSCL 14E

The measurement capabilities of laser velocimetry and holographic interferometry in transonic airfoil testing were demonstrated Presented are representative results obtained with these two nonintrusive techniques on a 15 24 cm chord airfoil section These results include the density field about the airfoil flow angles in the inviscid flow and viscous flow properties including the turbulent Reynolds stresses The accuracies of the density fields obtained by interferometry were verified from comparisons with surface pressure and laser velocimeter measurements L.S

N79-20000*# National Aeronautics and Space Administration Flight Research Center Edwards Calif
SECTION DRAG COEFFICIENTS FROM PRESSURE PROBE TRANSVERSES OF A WING WAKE AT LOW SPEEDS
Lawrence C Montoya Paul F Bikle (Soaring Society of America) and Richard D Banner *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 601-621 refs

Avail NTIS HC A14/MF A01 CSCL 01A
An in-flight wing wake section drag investigation was conducted using traversing pitot and static probes The primary objective was to develop measurement techniques and improve the accuracy of in-flight wing profile drag measurements for low values of dynamic pressure and Reynolds number Data were obtained on a sailplane for speeds from about 40 knots to 125 knots at chord Reynolds numbers between 1 000 000 and 3 000 000 Tests were conducted with zero flap deflection deflected flaps and various degrees of surface roughness and for smooth and rough atmospheric conditions Several techniques were used to increase data reliability and to minimize certain bias errors A discussion of the effects of a total pressure probe in a pressure gradient and the effects of discrete turbulence levels on the data presented and other experimental results is also included L.S

N79-20001*# Ohio State Univ Columbus Aeronautical and Astronautical Research Lab
FLIGHT TEST TECHNIQUES FOR LOW SPEED AIRFOIL EVALUATION
M J Hoffmann G M Gregorek and G S Weislogel *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 623 642 refs

Avail NTIS HC A14/MF A01 CSCL 01C
Techniques for in-flight evaluation of new airfoils by modifying a single engine general aviation aircraft and measuring and recording airfoil surface pressures airfoil wake pressures and aircraft angle of attack and airspeed are presented Included are descriptions of the aircraft modifications instrumentation data reduction techniques illustrations of typical results and comments on new equipment for flight test applications Author

N79-20002*# National Aeronautics and Space Administration Flight Research Center Edwards Calif
IN FLIGHT THREE-DIMENSIONAL BOUNDARY LAYER AND WAKE MEASUREMENTS FROM A SWEPT SUPERCRITICAL WING
David P Lux *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 643-655 refs

Avail NTIS HC A14/MF A01 CSCL 01A
Three dimensional boundary layer and wake velocity profiles were measured in flight on the supercritical wing of the F-111 transonic aircraft technology aircraft These data along with pressure distributions were obtained to establish a data base with which data obtained by three-dimensional analytical techniques could be correlated Only a brief summary of the total data base is given The data presented represented one chord station at a wing leading-edge sweep angle of 26 deg They cover an angle of attack range from 6 degs to 9 degs at free stream Mach numbers from 0 85 to 0 90 A brief discussion of the techniques used to obtain the boundary layer and wake profiles is included Author

N79-20003*# Boeing Commercial Airplane Co Seattle Wash
A PROCEDURE FOR ANALYZING TRANSONIC FLOW OVER HARMONICALLY OSCILLATING AIRFOILS
Warren H Weatherill F Edward Ehlers and James D Sebastian *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 657-670 refs

Avail NTIS HC A14/MF A01 CSCL 01A
Finite difference procedures were successfully used to solve the steady transonic flow about airfoils and appear to provide a practical means for calculating the corresponding unsteady flow The purpose of the paper is to describe a finite difference procedure derived from the equations for the potential flow by assuming small perturbations and harmonic motion The velocity potential is divided into steady and unsteady parts and the resulting unsteady equation is linearized on the basis of small amplitudes of oscillation The steady velocity potential which must be calculated first is described by the classical nonlinear transonic differential equation Author

N79-20004*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
A NEW TWO DIMENSIONAL OSCILLATING WING APPARATUS FOR UNSTEADY AERODYNAMICS RESEARCH

Sanford S Davis and Gerald N Malcolm *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 671-688 refs
Avail NTIS HC A14/MF A01 CSCL 14B
An apparatus for experimental research into unsteady transonic flows is described The apparatus as installed in the NASA Ames 11 by 11 Foot Transonic Wind Tunnel can impart full two-degree of freedom motions at reduced frequencies to 0 3 oscillatory amplitudes to tn-2 degs mean angles to 12 degs Mach numbers to 1 4 and Reynolds numbers to 12x10 The test wing is fully instrumented for dynamic waveform measurements and the data can be acquired processed and displayed in real-time with a new computational data acquisition system Following a description of the apparatus sample data from a recently completed test program is presented L.S

N79-20005*# National Aeronautics and Space Administration Langley Research Center Hampton Va
SOME CALCULATIONS OF TRANSONIC POTENTIAL FLOW FOR THE NACA 64A006 AIRFOIL WITH OSCILLATING FLAP
Robert M Bennett and Samuel R Bland *In its* Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 689-700 refs

Avail NTIS HC A14/MF A01 CSCL 01A
A method for calculating the transonic flow over steady and oscillating airfoils was developed by Isogai It solves the full potential equation with a semi-implicit time-marching finite difference technique Steady flow solutions are obtained from time asymptotic solutions for a steady airfoil Corresponding oscillatory solutions are obtained by initiating an oscillation and marching in time for several cycles until a converged periodic solution is achieved In this paper the method is described in general terms and results are compared with experimental data for both steady flow and for oscillations at several values of reduced frequency Good agreement for static pressures is shown for subcritical speeds with increasing deviation as Mach number is increased into the supercritical speed range Fair agreement with experiment was obtained at high reduced frequencies with larger deviations at low reduced frequencies Author

N79-20006*# Boeing Vertol Co Philadelphia Pa
OBSERVATIONS ON THE DYNAMIC STALL CHARACTERISTICS OF ADVANCED HELICOPTER ROTOR AIRFOILS

L. Dadone *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 701-715 refs

Avail NTIS HC A14/MF A01 CSCL 01C

A significant amount of research was devoted to understanding the mechanism of dynamic stall delay as applicable to the flow environment of a helicopter rotor in forward flight One aspect of such research deals with the unsteady characteristics of two-dimensional airfoil sections over a Mach number range from 0 3 to 9 6 since such characteristics can be meaningfully related to rotor performance and loads This paper summarizes the results of several oscillatory tests carried out on conventional transonic and BLC-equipped airfoils Author

N79-20007*# General Dynamics/Convair San Diego Calif
TRANSONIC FLOW OVER THE NACA 64A006 WITH AN OSCILLATING FLAP-CALCULATIONS BASED ON THE EULER EQUATIONS
R J Magnus *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 2 1978 p 717-728 refs

(Contract F33615-76 C-3018)
Avail NTIS HC A14/MF A01 CSCL 01A

Exploratory calculations of transonic flows over the airfoil with a quarter chord oscillating flap were made using a program which obtains approximate solutions to the Euler equations with an explicit shock-capturing finite-difference scheme The calculations essentially inviscid and for the airfoil at zero angle of-attack in a free stream are at Mach numbers and reduced frequencies which were tested in experiments by Tijdeman The oscillatory lifts from analogus calculations by various investigators generally agree with one another better than they agree with Tijdeman s data Inclusion in the calculations of an approximate modelling of boundary conditions expected at slotted wind tunnel walls tends to shift some of the results closer to the experimental values L S

N79-20008*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
MATERIALS AND STRUCTURAL ASPECTS OF ADVANCED GAS-TURBINE HELICOPTER ENGINES
John C Freche (US Army Aviation Res and Develop Command Cleveland) and John Acurio 1979 65 p refs To be presented at the Intern Congr in Aeron Paris 6-8 Jun 1979
(NASA-TM-79100 AVRADCOM-TR-79 4) Avail NTIS HC A04/MF A01 CSCL 21E

The key to improved helicopter gas turbine engine performance lies in the development of advanced materials and advanced structural and design concepts The modification of the low temperature components of helicopter engines (such as the inlet particle separator) the introduction of composites for use in the engine front frame the development of advanced materials with increased use-temperature capability for the engine hot section can result in improved performance and/or decreased engine maintenance cost A major emphasis in helicopter engine design is the ability to design to meet a required lifetime This in turn requires that the interrelated aspects of higher operating temperatures and pressures cooling concepts and environmental protection schemes be integrated into component design The major material advances coatings and design life-prediction techniques pertinent to helicopter engines are reviewed the current state-of-the-art is identified and when appropriate progress problems and future directions are assessed A R H

N79-20009# Advisory Group for Aerospace Research and Development Paris (France)
THE IMPACT OF INTEGRATED GUIDANCE AND CONTROL TECHNOLOGY ON WEAPONS SYSTEMS DESIGN
Dec 1978 242 p refs Presented at the Guidance and Control Panel Symp Sandefjord Norway 9 12 May 1978
(AGARD-CP-257 ISBN-92-835-1303-7) Avail NTIS HC A11/MF A01

Rapidly developing sensor technology when combined with advancing technologies in guidance and control the driving forces of acquisition and life cycle costs needs for operational tactical flexibility survivability vulnerability and critical volume and weight constraints dictates the need for integrated guidance and control at a higher functional level than heretofore considered This higher functional level involves an effective blend of the sensor vehicle and kill mechanism that can provide a multirole capability for advanced and present operational vehicles

N79-20013# Hughes Aircraft Co Canoga Park Calif
GLOBAL POSITIONING SYSTEM TACTICAL MISSILE GUIDANCE
Frederick W Hardy and C David DePriest (Air Force Armament Lab) *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 12 p refs

Avail NTIS HC A11/MF A01

The concept of GPS tactical missile guidance is discussed from the standpoint of advantages gained by high level functional integration between the missile and a GPS-equipped launch aircraft The conflicting requirements of high performance and low cost are shown to be attained by elimination of missile guidance functions that can be performed by the aircraft GPS system and transferred to the missile immediately prior to launch The importance of integrating missile GPS receiver and inertial guidance system measurements for achieving maximum performance in a jamming environment is discussed as well as the filter form employed and resulting performance The unique operational advantages of this GPS missile guidance system for weapon delivery are described including those gained by integration with a GPS equipped aircraft Author

N79-20015# Lear Siegler Inc Grand Rapids Mich
DEVELOPMENT OF THE INTEGRATED FLIGHT TRAJECTORY CONTROL CONCEPT
M W Bird W L Young (AFFDL) L Addis and G L Comegys *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 15 p refs

Avail NTIS HC A11/MF A01

Operational missions into heavily defended target zones with the likelihood for deviations from the intended routes and redirections from Command and Control centers will impose heavy workload demands upon the pilot/aircrew The approach selected by the integrated flight trajectory control (IFTC) program involves (1) combinating the functions of flight control systems and navigation computers (2) developing techniques for four dimensional trajectory generation and display and (3) develop ing procedures for operating on information received via data link The system is complementary to the pilot and by its logical operation reduces the potential for pilot error in high stress situations The operational advantages offered by the system and the method of evaluating its performance are discussed A R H

N79-20016# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
REDUNDANT STRAPDOWN NAVIGATION, GUIDANCE AND CONTROL OF A CONTROL CONFIGURED VEHICLE

Wolfgang J Kubbat and George A Napjus *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 18 p refs Prepared in cooperation with Teledyne Systems Co Northridge Calif

Avail NTIS HC A11/MF A01

The hardware and software mechanization of the integrated guidance and control system of the CCV-F104-G is explained with special focus on the strapdown part This includes the solution to the redundancy problem Finally the next feasible steps in system improvement and minimization of the inertial part are outlined Author

N79 20017# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
PRELIMINARY FEASIBILITY ASSESSMENT OF MULTI-FUNCTION INERTIAL REFERENCE ASSEMBLY (MIRA)

John M Perdzock and Robert C Burns *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 16 p ref Prepared in cooperation with

McDonnell Douglas Corp St Louis Mo

Avail NTIS HC A11/MF A01

Mission and performance goals established for MIRA feasibility studies covering flight control navigation and weapon/cargo delivery as applied to the F-15 aircraft and a transport aircraft are discussed The relationship between the key technical issues of concern and the feasibility criteria and the methodology to perform the trade-offs which impact life cycle costs are described Functional performance and reliability requirements are shown Computational requirements for a representative MIRA system are summarized Computer programs were used to evaluate time histories of sensor and system error propagation and to assess the impact on flight control system control laws as MIRA sensors are installed at various aircraft installation locations The criteria defined to perform the preliminary feasibility assessment is discussed Comparative studies of life cycle costs show a saving estimate in excess of 69 million dollars for MIRA application to a quantity of 144 fighters over a 15 year operational life Cost savings for transport applications are qualitatively significant particularly for the operations and support cost element The results of ring laser gyro and tuned rotor gyro studies of performance and reliability improvements required are summarized A R H

N79-20019# Marconi-Elliott Avionic Systems Ltd Borehamwood (England) Airborne Display Div

CONTROL AND DISPLAY CONCEPTS FOR COMBAT AIRCRAFT

R H Holmes *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 12 p

Avail NTIS HC A11/MF A01

The need for low pilot workload in future combat aircraft equipped with electronic displays is discussed Means by which this may be achieved through optimization of display functions and rationalization of controls are examined Current work on head up displays and helmet sighting systems is highlighted A R H

N79-20021# Forschungsinstitut fuer Anthropotechnik Meckenheim (West Germany)

METHODS FOR THE VALIDATION OF SYNTHESIZED IMAGES IN VISUAL FLIGHT SIMULATION

Gert Doerfel *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 10 p refs

Avail NTIS HC A11/MF A01

To validate the information content of synthetic visual flight simulation objectively based methods and criteria are necessary which can show the influence of a variety of visual cues on pilots perception Fifty six pilots and 28 nonpilot enlisted men made height and distance judgements from landing approach scenes with different levels of detail Some judgements of height and distance were made in relation to a previously shown standard scene Other judgements (absolute) were given in ft or m To evaluate the influence of scene information simplification on subjects perception of height and distance a number of measures were made including judgement time error and the exponent of the stimulus response relationship Judgement error and the exponent of fitted power-functions both were significantly influenced by scene stylization The increase of judgement error and the decrease of power-function exponent respectively are more distinct when making absolute judgement than relative ones Because results for pilots are quite different nonpilots should not be used as subjects for visual research work with landing scenes Author

N79 20022# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio

DESIGN CONSIDERATIONS FOR IMPLEMENTING INTEGRATED MISSION-TAILORED FLIGHT CONTROL MODES

James K Ramage and Frank R Swortzel *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 18 p refs

Avail NTIS HC A11/MF A01

Some of the more critical design considerations are discussed for successfully integrating decoupled flight path control mission-tailored control modes and fault in a multi-role high performance fighter aircraft design to achieve improved overall mission effectiveness and cost of ownership without sacrificing system reliability and safety The recently completed Fighter Control Configured Vehicles (CCV) Program flight test of the yf-16 aircraft provided valuable insight and substantiating technical data for future design and application of active control technology This program was primarily concerned with the development and evaulation of decoupled six degrees-of-freedom flight path control techniques Specific CCV features evaluated during the flight test program included (1) maneuver enhancement/gust alleviation (2) direct lift and sideforce control (3) independent fuselage pointing and translation and (4) variable relaxed static stability Implementation of these CCV capabilities presents unique pilot interface considerations which must be addressed in terms of required displays controllers vehicle response dynamics and mission segment applications A R H

N79 20023# Litton Systems Inc Woodland Hills Calif Guidance and Control Systems Div

TARGET MARKER PLACEMENT FOR DIVE-TOSS DELIVERIES WITH WINGS NON LEVEL

J Stanley Ausman *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 11 p

Avail NTIS HC A11/MF A01

In a dive-toss air-to ground weapon delivery the pilot steers a target marker symbol or sight reticle (pipper) so as to overlay the target with that symbol He then depresses a target designation (pickle) switch which commands the computer to record all available target sensor data From these data the weapon delivery computer first calculates the location of the target and then generates steering signals to guide the pilot in steering the calculated weapon impact point onto the target whereupon the computer automatically issues the weapon release signal The motion of the calculated impact point during a banked pullup or climbing turn is analyzed to determine the path followed by the calculated impact point during such a maneuver Placement of the sight reticle along this path allows the pilot to pull straight back on the stick after designating the target without first unrolling to a wings level attitude A R H

N79-20025# Laboratoire d Automatique et d Analyse des Systemes Toulouse (France)

A RELIABLE AND SURVIVABLE DATA TRANSMISSION SYSTEM FOR AVIONICS PROCESSING

D R Powell J C Laprie P Romand (Societe Crouzet) and G Alcouffe (Societe Crouzet) *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 12 p

Avail NTIS HC A11/MF A01

The interconnection of real-time processing elements is discussed with emphasis on the choice of a two level structure containing a distributed irregular network and a set of local star structures The irregular network has active nodes that carry out automatic signal routing whereas the star structure has a passive central node based on a loosely-coupled pulse transformer Two types of communication control presently under analysis are content control and a decentralized daisy chain The final choice will be based on security and modularity criteria A R H

N79-20026# Singer-Kearfott Wayne N J

DYNAMIC SIMULATION OF A MULTI-SENSOR COMMUNICATION AND NAVIGATION SYSTEM

Joseph N Frisina William J Steele and Jory I Schlenger *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 13 p

Avail NTIS HC A11/MF A01

Multi-sensor communication and navigation system avionic software is comprised of a real-time airborne operating system (RTAOS) a communication subsystem based on the time division muxiplexed access (TDMA) method a tactical navigation (TACAN)

subsystem and a relative navigation (REL NAV) subsystem Because this avionic software was written in assembly language there existed a very stringent requirement for a dynamic simulator for both development and validation of the avionic software COMMANDS was developed to meet this requirement for an economical tool that would support the test requirements of both the communication (TDMA) subsystem s high data rates and the complex computational requirement of the relative navigation system The COMMANDS simulator is resident on a mini-computer and is physically connected to the JTIDS Class 2 operational flight program terminal through the operational input/output I/O devices This allows the simulation of the avionic box which is receiving the same inputs in the laboratory test as it will under flight conditions A R H

N79-20028# British Aerospace Aircraft Group Warton (England)
MISSION SIMULATION AS AN AID TO DISPLAY ASSESSMENT
P Beckett and D E A Houghton *In* AGARD The Impact of Integrated Guidance and Control Technol on Weapons Systems Design Dec 1978 12 p

Avail NTIS HC A11/MF A01
Advances in computer and display technology make possible drastic changes in aircraft cockpit layout Investigations involving full mission simulation in an advanced cockpit environment are reported The philosophies and methods adopted and the hardware required for such simulation are discussed and areas where problems were encountered are indicated A R H

N79-20029# Advisory Group for Aerospace Research and Development Paris (France)
HIGHLIGHTS
Mar 1979 36 p
(AGARD-HIGHLIGHTS-79/1) Avail NTIS HC A03/MF A01
Topics covered include the Von Karman medal 1978 Portuguese National Day biographical sketches of the newly appointed AGARD chairman Allan M Lovelace and director Jack Burnham prospects for propulsion and energetics summary of 1979 meeting themes and obituary for Michael Anastassides A R H

N79-20030*# National Aeronautics and Space Administration Langley Research Center Hampton Va
ADVANCED TECHNOLOGY AIRFOIL RESEARCH VOLUME 1 PART 1
1979 454 p refs Conf held at Hampton Va 7 9 Mar 1978
(NASA-CP-2045-Vol-1-Pt-1, L-12232) Avail NTIS HC A20/MF A01 CSCL 01A
A comprehensive review of all NASA airfoil research conducted both in-house and under grant and contract as well as a broad spectrum of airfoil research outside of NASA is presented Emphasis is placed on the development of computational aerodynamic codes for airfoil analysis and design the development of experimental facilities and test techniques and all types of airfoil applications

N79-20031*# National Aeronautics and Space Administration Washington D C
NASA RESEARCH OBJECTIVES AND ROLES
Alfred Gessow *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 1-9

Avail NTIS HC A20/MF A01 CSCL 01A
A chronology of airfoil development is presented in order to put the present NASA airfoil program in perspective The impact of the NACA series airfoils is considered Development of advanced analytical and experimental methods for the design and for the determination of the characteristics of not only single element airfoils but of multielement airfoil combinations used in aerodynamic controls and high lift systems is emphasized along with applications J M S

N79-20032*# National Aeronautics and Space Administration Langley Research Center Hampton Va
LANGLEY AIRFOIL-RESEARCH PROGRAM
Percy J Bobbitt *In its* Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 11-38 refs

Avail NTIS HC A20/MF A01 CSCL 01A
An overview of past present and future airfoil research activities at the Langley Research Center is given The immediate past and future occupy most of the discussion however past accomplishments and milestones going back to the early NACA years are dealt with in a broad-brush way to give a better perspective of current developments and programs In addition to the historical perspective a short description of the facilities which are now being used in the airfoil program is given This is followed by a discussion of airfoil developments advances in airfoil design and analysis tools (mostly those that have taken place over the past 5 or 6 years) and tunnel-wall-interference predictive methods and measurements Future research requirements are treated J M S

N79-20033*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
OVERVIEW OF TWO DIMENSIONAL AIRFOIL RESEARCH AT AMES RESEARCH CENTER
Gary T Chapman *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 39-44 ref

Avail NTIS HC A20/MF A01 CSCL 01A
The five basic elements of the two dimensional airfoil research program at Ames Research Center are illustrated These elements are experimental theoretical (including computational) validation design optimization and industry interaction Each area is briefly discussed J M S

N79-20034*# New York Univ N Y
TRANSONIC AIRFOIL CODES
P R Garabedian *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 45-54 refs

(Grants NGR-33 016 167 NGR-33-016-201 Contract EX-76-C 02-3077)
Avail NTIS HC A20/MF A01 CSCL 01A
Computer codes for the design and analysis of transonic airfoils are considered The design code relies on the method of complex characteristics in the hodograph plane to construct shockless airfoil The analysis code uses artificial viscosity to calculate flows with weak shock waves at off-design conditions Comparisons with experiments show that an excellent simulation of two dimensional wind tunnel tests is obtained The codes have been widely adopted by the aircraft industry as a tool for the development of supercritical wing technology J M S

N79 20035*# Texas A&M Univ College Station
APPLICATION OF DIRECT-INVERSE TECHNIQUES TO AIRFOIL ANALYSIS AND DESIGN
Leland A Carlson and Bruce M Rocholl *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 55-72 refs
(Grant NsG-1174)
Avail NTIS HC A20/MF A01 CSCL 01A
The direct-inverse technique was developed into a numerical method called TRANDES that is suitable for the analysis and design of subsonic and transonic airfoils and for the evaluation of design concepts A general description of the method is given and its application to a design analysis type of problem is demonstrated A usage of the method for the low speed high lift case is discussed J M S

N79-20036*# National Aeronautics and Space Administration Langley Research Center Hampton Va
LOW SPEED AIRFOIL DESIGN AND ANALYSIS
Richard Eppler (Stuttgart Univ West Germany) and Dan M Somers *In its* Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 73-100 refs

Avail NTIS HC A20/MF A01 CSCL 01A

A low speed airfoil design and analysis program was developed which contains several unique features In the design mode the velocity distribution is not specified for one but many different angles of attack Several iteration options are included which allow the trailing edge angle to be specified while other parameters are iterated For airfoil analysis a panel method is available which uses third-order panels having parabolic vorticity distributions The flow condition is satisfied at the end points of the panels Both sharp and blunt trailing edges can be analyzed The integral boundary layer method with its laminar separation bubble analog empirical transition criterion and precise turbulent boundary layer equations compares very favorably with other methods both integral and finite difference Comparisons with experiment for several airfoils over a very wide Reynolds number range are discussed Applications to high lift airfoil design are also demonstrated J M S

N79-20038*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
PROSPECTS FOR COMPUTING AIRFOIL AERODYNAMICS WITH REYNOLDS AVERAGED NAVIER-STOKES CODES
George S Deiwert and H E Bailey *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 119 131 refs
Avail NTIS HC A20/MF A01 CSCL 01A

The Reynolds averaged Navier-Stokes equations are solved numerically for a variety of transonic airfoil configurations where viscous phenomena are important Illustrative examples include flows past sensitive geometries Reynolds number effects and buffet phenomena J M S

N79-20039*# Ohio State Univ Columbus General Aviation Airfoil Design and Analysis Center
AN EVALUATION OF FOUR SINGLE ELEMENT AIRFOIL ANALYTIC METHODS
R J Freuler and G M Gregorek *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 133 162 refs
(Contract NAS1 14406)
Avail NTIS HC A20/MF A01 CSCL 01A

A comparison of four computer codes for the analysis of two dimensional single element airfoil sections is presented for three classes of section geometries Two of the computer codes utilize vortex singularities methods to obtain the potential flow solution The other two codes solve the full inviscid potential flow equation using finite differencing techniques allowing results to be obtained for transonic flow about an airfoil including weak shocks Each program incorporates boundary layer routines for computing the boundary layer displacement thickness and boundary layer effects on aerodynamic coefficients Computational results are given for a symmetrical section represented by an NACA 0012 profile a conventional section illustrated by an NACA 65A413 profile and a supercritical type section for general aviation applications typified by a NASA LS(1)-0413 section The four codes are compared and contrasted in the areas of method of approach range of applicability agreement among each other and with experiment individual advantages and disadvantages computer run times and memory requirements and operational idiosyncrasies J M S

N79-20040*# Boeing Co Seattle Wash
UPGRADED VISCOUS FLOW ANALYSIS OF MULTI-ELEMENT AIRFOILS
Guenter W Brune and Joseph W Manke *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 163-181 refs
(Contract NAS1-14522)
Avail NTIS HC A20/MF A01 CSCL 01A

A description of an improved version of the NASA/Lockheed multi element airfoil analysis computer program is presented The improvements include several major modifications of the aerodynamic model as well as substantial changes of the computer code The modifications of the aerodynamic model comprise the representation of the boundary layer and wake displacement effects with an equivalent source distribution the prediction of wake parameters with Green s lag entrainment method the calculation of turbulent boundary layer separation with the method of Nash and Hicks the estimation of the onset of confluent boundary layer separation with a modified form of Goradia s method and the prediction of profile drag with the formula of Squire and Young The modifications of the computer program for which the structured approach to computer software development was employed are also described Important aspects of the structured program development such as the functional decomposition of the aerodynamic theory and its numerical implementation the analysis of the data flow within the code and the application of a pseudo code are discussed J M S

N79-20041*# Mississippi State Univ State College
NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR ARBITRARY TWO-DIMENSIONAL MULTI-ELEMENT AIRFOILS
Joe F Thompson Louie Turner W Serrill Long and John H Bearden *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 183-207 refs

(Grant NGR-25 001-005)
Avail NTIS HC A20/MF A01 CSCL 01A

The development of a numerical simulation of time dependent turbulent compressible flow about two dimensional multi element airfoils of arbitrary shape is described The basis of this simulation is a technique of automatic numerical generation of coordinate systems fitted to the multiple bodies regardless of their number or shape Procedures developed whereby the coordinate lines are automatically concentrated in the boundary layer at any Reynolds number are discussed The compressible turbulent solution involves an algebraic eddy viscosity turbulence model The laminar version was run for transonic flow at free stream Mach numbers up to 0 9 J M S

N79-20042*# Grumman Aerospace Corp Bethpage N Y
THE ANALYSIS AND DESIGN OF TRANSONIC TWO-ELEMENT AIRFOIL SYSTEMS
G Volpe and B Grossman *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 209-220 refs
(Contract N00014-75 C 0722)
Avail NTIS HC A20/MF A01 CSCL 01A

The multiphase effort in the development of tools for the analysis and design of two-element airfoil systems that is airfoils with a slat or a flap at transonic speeds is described The first phase involved the development of a method to compute the inviscid flow over such configurations In the second phase the inviscid code was coupled to a boundary layer calculation program in order to compute the loss in performance due to viscous effects An inverse code that constructs the airfoil system corresponding to a desired pressure distribution is described J M S

N79-20043*# McDonnell Aircraft Co St Louis Mo
IMPROVEMENTS IN SURFACE SINGULARITY ANALYSIS AND DESIGN METHODS
Dean R Bristow *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 221-236 refs

Avail NTIS HC A20/MF A01 CSCL 01A

The coupling of the combined source vortex distribution of Green s potential flow function with contemporary numerical techniques is shown to provide accurate efficient and stable solutions to subsonic inviscid analysis and design problems for multi element airfoils The analysis problem is solved by direct calculation of the surface singularity distribution required to satisfy the flow tangency boundary condition The design or inverse problem is solved by an iteration process In this process the geometry and the associated pressure distribution are iterated until the pressure distribution most nearly corresponding to the prescribed design distribution is obtained Typically five iteration cycles are required for convergence A description of the analysis and design method is presented along with supporting examples J M S

N79-20044*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
OPTIMIZATION OF MULTI-ELEMENT AIRFOILS FOR MAXIMUM LIFT
Lawrence E Olsen *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 237-253 refs

Avail NTIS HC A20/MF A01 CSCL 01A

Two theoretical methods are presented for optimizing multi element airfoils to obtain maximum lift The analyses assume that the shapes of the various high lift elements are fixed The objective of the design procedures is then to determine the optimum location and/or deflection of the leading and trailing edge devices The first analysis determines the optimum horizontal and vertical location and the deflection of a leading edge slat The structure of the flow field is calculated by iteratively coupling potential flow and boundary layer analysis This design procedure does not require that flow separation effects be modeled The second analysis determines the slat and flap deflection required to maximize the lift of a three element airfoil This approach requires that the effects of flow separation from one or more of the airfoil elements be taken into account The theoretical results are in good agreement with results of a wind tunnel test used to corroborate the predicted optimum slat and flap positions
J M S

N79-20045*# Grumman Aerospace Corp Bethpage N Y
WAKE CURVATURE AND TRAILING EDGE INTERACTION EFFECTS IN VISCOUS FLOW OVER AIRFOILS
R E Melnik *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 255-270 refs

(Contract NAS1 12426)
Avail NTIS HC A20/MF A01 CSCL 01A

A theory developed for analyzing viscous flows over airfoils at high Reynolds numbers is described The theory includes a complete treatment of viscous interaction effects induced by the curved wake behind the airfoil and accounts for normal pressure gradients across the boundary layer in the trailing edge region A brief description of a computer code that was developed to solve the extended viscous interaction equations is given Comparisons of the theoretical results with wind tunnel data for two rear loaded airfoils at supercritical conditions are presented
J M S

N79-20047*# Flow Research Inc Kent Wash
RECENT DEVELOPMENTS IN FINITE ELEMENT ANALYSIS FOR TRANSONIC AIRFOILS
M M Hafez and E M Murman *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 281-296 refs
(Contract NAS1-14246)
Avail NTIS HC A20/MF A01 CSCL 01A

The prediction of aerodynamic forces in the transonic regime generally requires a flow field calculation to solve the governing non linear mixed elliptic hyperbolic partial differential equations Finite difference techniques were developed to the point that design and analysis application are routine and continual improvements are being made by various research groups The principal limitation in extending finite difference methods to complex three dimensional geometries is the construction of a suitable mesh system Finite element techniques are attractive since their application to other problems have permitted irregular mesh elements to be employed The purpose of this paper is to review the recent developments in the application of finite element methods to transonic flow problems and to report some recent results
L S

N79-20048*# General Dynamics/Convair San Diego Calif
SUPERCRITICAL TESTS OF A SELF-OPTIMIZING VARIABLE-CAMBER WIND TUNNEL MODEL
Ely S Levinsky and Richard L Palko (ARO Inc) *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 297-313 refs Sponsored in part by AFFDL, Wright-Patterson AFB
(Contract N00014 76 C 0742)
Avail NTIS HC A20/MF A01 CSCL 01A

A testing procedure was used in a 16-foot Transonic Propulsion Wind Tunnel which leads to optimum wing airfoil sections without stopping the tunnel for model changes Being experimental the optimum shapes obtained incorporate various three dimensional and nonlinear viscous and transonic effects not included in analytical optimization methods The method is a closed-loop computer-controlled interactive procedure and employs a Self-Optimizing Flexible Technology wing semispan model that conformally adapts the airfoil section at two spanwise control stations to maximize or minimize various prescribed merit functions subject to both equality and inequality constraints The model which employed twelve independent hydraulic actuator systems and flexible skins was also used for conventional testing Although six of seven optimizations attempted were at least partially convergent further improvements in model skin smoothness and hydraulic reliability are required to make the technique fully operational
L S

N79-20049*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
APPLICATION OF NUMERICAL OPTIMIZATION TO THE DESIGN OF ADVANCED SUPERCRITICAL AIRFOILS
Raymond R Johnson (Vought Corp) and Raymond M Hicks *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 315-325 refs

Avail NTIS HC A20/MF A01 CSCL 01A

An application of numerical optimization to the design of advanced airfoils for transonic aircraft showed that low drag sections can be developed for a given design Mach number without an accompanying drag increase at lower Mach numbers This is achieved by imposing a constraint on the drag coefficient at an off design Mach number while minimizing the drag coefficient at the design Mach number This multiple design-point numerical optimization has been implemented with the use of airfoil shape functions which permit a wide range of attainable profiles during the optimization process Analytical data for the starting airfoil shape a single design point optimized shape and a double design point optimized shape are presented Experimental data obtained in the NASA Ames two by two foot wind tunnel are also presented and discussed
L S

N79-20050*# McDonnell Aircraft Co St Louis Mo
IMPROVED PREDICTION OF LAMINAR LEADING EDGE SEPARATION
R N Herring and W L Ely *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 327-334 refs
Avail NTIS HC A20/MF A01 CSCL 01A

Research was conducted to provide a definite criterion for the prediction of the bubble burst on airfoils typical of those used for fighter wings The approach taken was to correlate existing airfoil bubble burst data using various parameters at the laminar separation point The method due to Weber was modified to provide a continuous analytic solution for the velocity distribution around the airfoil leading edge Coupling the modified Weber method with the Stratford laminar separation prediction method leads to a universal chart giving the conditions at separation as a function of stagnation location and leading edge radius Application of the combined method to available two dimensional airfoil data resulted in an empirical criterion presenting the limiting local velocity gradient at separation as a function of the boundary layer momentum thickness at separation for bubble burst The correlation leads as well to the qualitative explanation of two types of laminar stall thin airfoil and leading edge The validity of the correlation is demonstrated by predicting the lift coefficient and angle of attack for stall on airfoils with leading edge or trailing edge flaps
L S

N79 20051*# McDonnell Aircraft Co St Louis Mo
THE PREDICTION OF TWO-DIMENSIONAL AIRFOIL STALL PROGRESSION
Lloyd W Gross *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 335 345 refs

Avail NTIS HC A20/MF A01 CSCL 01A

A generalized boundary condition potential flow calculation method was combined with a momentum integral boundary layer method and a base flow theory of separation to predict airfoil viscous inviscid interference up to and beyond stall The resultant program considers laminar and turbulent separation and is therefore applicable to thin or thick airfoil stall The calculated flow field includes the airfoil and the separation bubble recombination region behind the airfoil Calculated pressure distributions and equivalent airfoil shapes including the displacement thickness of the viscous regions are compared with flow field measurements for several airfoils The measured displacement thicknesses and wake centerlines corroborate the calculated shape The comparison also suggests the use of the analytical solution to evaluate the measurements LS

N79-20052*# Analytical Methods Inc Bellevue Wash
APPLICATION OF THE AMI C SUB I SUB max PREDICTION METHOD TO A NUMBER OF AIRFOILS
F A Dvorak and B Maskew *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 347-365 refs
(Contract DAAG29-76-C 0019)
Avail NTIS HC A20/MF A01 CSCL 01A

A method for calculating the flow about airfoils up to and beyond the stall is described It is an iterative procedure between potential flow and boundary layer solutions The separated region is modeled in the potential flow analysis using free vortex sheets which require an inner iteration to establish their shapes The free vortex sheet length is an important parameter in the potential flow calculation Results so far indicate a possible correlation between wake length and airfoil thickness/chord ratio Calculated and experimental results are compared for a series of airfoils Author

N79-20053*# Wichita State Univ Kans
A NEW FLOW MODEL FOR HIGHLY SEPARATED AIRFOIL FLOWS AT LOW SPEEDS
Glen W Zumwalt and Sharad N Naik *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 367-382 refs
(Grant NsG-1192)
Avail NTIS HC A20/MF A01 CSCL 01A

An analytical model for separated airfoil flows is presented which is based on experimentally observed physical phenomena These include a free stagnation point aft of the airfoil and a standing vortex in the separated region A computer program is described which iteratively matches the outer potential flow the airfoil turbulent boundary layer the separated jet entrainment mass conservation in the separated bubble and the rear stagnation pressure Separation location and pressure are not specified a priori Results are presented for surface pressure coefficient and compared with experiment for three angles of attack for a GA(W)-1 17% thick airfoil Author

N79-20054*# Boeing Commercial Airplane Co Seattle Wash
INVERSE BOUNDARY-LAYER TECHNIQUE FOR AIRFOIL DESIGN
M L Henderson *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 383-397 refs
Avail NTIS HC A20/MF A01 CSCL 01A

A description is presented of a technique for the optimization of airfoil pressure distributions using an interactive inverse boundary layer program This program allows the user to determine quickly a near-optimum subsonic pressure distribution which meets his requirements for lift drag and pitching moment at the desired flow conditions The method employs an inverse turbulent boundary layer scheme for definition of the turbulent recovery portion of the pressure distribution Two levels of pressure-distribution architecture are used - a simple roof top for preliminary studies and a more complex four-region architecture for a more refined design A technique is employed to avoid the specification of pressure distributions which result in unrealistic airfoils that is those with negative thickness The program allows rapid evaluation of a designed pressure distribution off-design in Reynolds number transition location and angle of attack and will compute an airfoil contour for the designed pressure distribution using linear theory LS

N79-20055*# National Aeronautics and Space Administration Langley Research Center Hampton Va
LANGLEY'S TWO DIMENSIONAL RESEARCH FACILITIES CAPABILITIES AND PLANS
Edward J Ray *In its* Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 399-414 refs

Avail NTIS HC A20/MF A01 CSCL 01A

The current capabilities and the forthcoming plans for Langley s two dimensional research facilities are described The characteristics of the Langley facilities are discussed in terms of Reynolds number Mach number and angle of-attack capabilities Comments are made with regard to the approaches which have been investigated to alleviate typical problem areas such as wall boundary effects Because of the need for increased Reynolds number capability at high subsonic speeds a considerable portion of the paper deals with a description of the 20 by 60 cm two dimensional test section of the Langley 0 3 meter transonic cryogenic tunnel which is currently in the calibration and shakedown phase LS

N79 20056*# Southampton Univ (England)
DEVELOPMENTS IN TESTING AIRFOIL TECHNIQUES AT UNIVERSITY OF SOUTHAMPTON
Michael J Goodyer *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 415-423 refs

(Grant NsG-7172)
Avail NTIS HC A20/MF A01 CSCL 01A

The evolution in Europe of the flexible walled test section as applied to two dimensional testing at low and transonic speeds is traced from its beginnings at NPL London in the early 1940 s and is shown to lead logically to the latest version now nearing completion at Southampton University The principal changes that have taken place are improvements in the methods of choosing wall contours such that they rapidly follow appropriate streamlines and reductions in the depth of test sections The latest transonic test section presently under assembly at Southampton has as its principal new feature the facility for the automation of wall streamlining with the aid of an on line computer The versatility of the flexible walled test section is emphasized by reference to the simulation of alternative flows including cascade steady pitching in an infinite flowfield and ground effect Finally sources of error in streamlining are identified with methods for their alleviation LS

N79 20057*# National Aeronautics and Space Administration Langley Research Center Hampton Va
A NEW AIRFOIL RESEARCH CAPABILITY
Charles L Ladson *In its* Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 425-432 refs

Avail NTIS HC A20/MF A01 CSCL 01A

The design and construction of a self streamlining wall test section for the Langley 0 3 meter transonic cryogenic tunnel was included in the fiscal year 1978 construction of facilities budget for Langley Research Center The design is based on the research being carried out by M J Goodyer at the University of Southampton Southampton England and is supported by Langley Research Center This paper presents a brief description of the project Included are some of the design considerations anticipated operational envelope and sketches showing the detail design concepts Some details of the proposed operational mode safety aspects and preliminary schedule are presented Author

N79-20058*# National Aeronautics and Space Administration Langley Research Center Hampton Va
DESIGN AND CALIBRATION OF SLOTTED WALLS FOR TRANSONIC AIRFOIL WIND TUNNELS
Richard W Barnwell William G Sewall and Joel L Everhart *In its* Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 433-443 refs
Avail NTIS HC A20/MF A01 CSCL 01A

The traditional procedure for estimating the performance of slotted walls for airfoil wind tunnels is reviewed and a modification which improves the accuracy of this procedure is described Unlike the traditional procedure the modified procedure indicates that the design of airfoil wind-tunnel walls which induce minimal blockage and streamline curvature effects is feasible The design and testing of such a slotted wall is described It is shown experimentally that the presence of a model can affect the plenum pressure and thus make the use of the plenum pressure as a calibration reference questionable Finally an ONERA experiment which shows the effect of the sidewall boundary layer on the measured model normal force is discussed Author

N79-20059*# United Technologies Research Center East Hartford Conn
SOME STEADY AND OSCILLATING AIRFOIL TEST RESULTS INCLUDING THE EFFECTS OF SWEEP FROM THE TUNNEL SPANNING WING Progress Report
Franklin O Carta Arthur O St Hilaire James B Rorke (United Technologies Corp) and W Donald Jepson (United Technologies Corp) *In* NASA Langley Res Center Advanced Technol Airfoil Res Vol 1 Pt 1 1979 p 445 458 refs

Avail NTIS HC A20/MF A01 CSCL 01A

A large scale tunnel spanning wing was built and tested The model can be operated as either a swept or unswept wing and can be tested in steady state or oscillated sinusoidally in pitch about its quarter chord Data is taken at mid-span with an internal 6 component balance and is also obtained from miniature pressure transducers distributed near the center span region A description is given of the system and a brief discussion of some of the steady and unsteady results obtained to date These are the steady load behavior to Mach numbers of approximately 1 1 and unsteady loads including drag at a reduced frequency of approximately 0 1 L S

N79 20061*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
COMPUTATION OF TURBULENT NEAR WAKE FOR ASYMMETRIC AIRFOILS
George S Deiwert Mar 1979 16 p refs Presented at the DEA meeting on Viscous and Interacting Flow Field Effects Meersburg/Bodensee West Germany 24-26 Apr 1979
(NASA-TM-78581 A-7803) Avail NTIS HC A02/MF A01 CSCL 01A

A numerical procedure for studying the turbulent near wake of two dimensional airfoil sections is presented The Reynolds Navier-Stokes equations were written for flow about bodies of arbitrary geometry and solved on an arbitrary nonuniform curvilinear computational mesh Eddy viscosity and Reynolds stress turbulence transport models are considered Specific examples are shown for airfoil section by using an algebraic viscosity model with streamwise relaxation and the interactive Reynolds stress model S E S

N79 20062*# National Aeronautics and Space Administration Langley Research Center Hampton Va
EXPERIMENTAL AERODYNAMIC CHARACTERISTICS AT MACH NUMBERS FROM 0 60 TO 2 70 OF TWO SUPERSONIC CRUISE FIGHTER CONFIGURATIONS
Samuel M Dollyhigh Feb 1979 190 p
(NASA-TM-78764 L-12426) Avail NTIS HC A09/MF A01 CSCL 01A

Two 0 085-scale full span wind tunnel models of a Mach 1 60 design supercruiser configuration were tested at Mach numbers from 0 60 to 2 70 One model incorporated a varying dihedral (swept-up) wing to obtain the desired lateral directional characteristics the other incorporated more conventional twin vertical tails The data from the wind-tunnel tests are presented without analysis Author

N79 20063*# National Aeronautics and Space Administration Langley Research Center Hampton Va
SUBSONIC LONGITUDINAL AND LATERAL AERODYNAMIC CHARACTERISTICS FOR A SYSTEMATIC SERIES OF STRAKE-WING CONFIGURATIONS
James M Luckring Feb 1979 219 p refs
(NASA-TM-78642) Avail NTIS HC A10/MF A01 CSCL 01A

A systematic wind tunnel study was conducted in the Langley 7 by 10 foot high speed tunnel to help establish a parametric data base of the longitudinal and lateral aerodynamic characteristics for configurations incorporating strake-wing geometries indicative of current and proposed maneuvering aircraft The configurations employed combinations of strakes with reflexed planforms having exposed spans of 10% 20% and 30% of the reference wing span and wings with trapezoidal planforms having leading edge sweep angles of approximately 30 40 44 50 and 60 deg Tests were conducted at Mach numbers ranging from 0 3 to 0 8 and at angles of attack from approximately -4 to 48 deg at zero sideslip J A M

N79-20065*# New York Univ N Y Courant Inst of Mathematical Sciences
NUMERICAL DESIGN OF SHOCKLESS AIRFOILS Final Technical Report 1 Sep 1970 - 28 Feb 1979
Paul R Garabedian 28 Feb 1979 8 p refs
(Grant NGR-33 016 167)
(NASA-CR-158439) Avail NTIS HC A02/MF A01 CSCL 01A

An attempt is made to indicate and briefly discuss only the most significant achievements of the research The most successful contribution from the contract was the code for two dimensional analysis of airfoils in transonic flow G Y

N79-20068*# Rockwell International Corp Downey Calif
PREDICTION OF IN DEPTH GAP HEATING RATIOS FROM WING GLOVE MODEL TEST DATA
3 Nov 1977 57 p refs
(Contract NAS9 14000)
(NASA-CR-160146 SEH-ITA-77-245) Avail NTIS HC A04/MF A01 CSCL 20D

In depth gap heating ratios were predicted down RSI tile sidewalls based on temperature measurements obtained from the JSC arc-jet Wing Glove model tests in order to develop gap heating ratios which resulted in the best possible fit of test data and to produce a set of engineering verification heating ratios similar in shape to one another which could be used at various body points on the Orbiter during reentry The Rockwell TPS Multidimensional heat conduction program was used to perform 3-D thermal analyses using a 3 0 in thick section of a curved RSI tile with 283 nodal points Correlation with test data shows that the predicted heating ratios were significatnly higher down in the gap than the zero pressure values for T/C stacks 39 and 38 on the Wing Glove model For stack 37 (in a low pressure region) the baseline heating ratio overpredicted the temperature data This analysis which showed that the heating ratios were a strong function of the product of pressure and pressure gradient will be used to compare with recent Gap/Step and Ames Double Wedge test/analysis results in the effort to identify the Orbiter gap response to high delta P flight environment A R H

N79-20069*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
WIND TUNNEL PERFORMANCE OF FOUR ENERGY EFFICIENT PROPELLERS DESIGNED FOR MACH 0 8 CRUISE
Robert J Jeracki Daniel C Mikkelson and Bernard J Blaha 1979 24 p refs Presented at the Business Aircraft Meeting Wichita Kansas 3 6 Apr 1979 sponsored by the Soc of Automotive Engr
(NASA-TM-79124 E 9960) Avail NTIS HC A02/MF A01 CSCL 01A

Several advanced aerodynamic and acoustic concepts were investigated in recent wind tunnel tests performed in the NASA-Lewis Research Center 8x6 foot wind tunnel These concepts included aerodynamically integrated propeller/nacelles area ruling blade sweep reduced blade thickness and power (disk) loadings several times higher than conventional designs Four eight-bladed propeller models were tested to determine

aerodynamic performance Relative noise measurements were made on three of the models at cruise conditions Three of the models were designed with swept blades and one with straight blades At the design Mach number of 0 8 power coefficient of 1 7 and advance ratio of 3 06 the straight bladed model had the lowest net efficiency of 75 8 percent Increasing the sweep to 30 deg improved the performance to near 77 percent Installation of an area-ruled spinner on a 30 deg sweep model further improved the efficiency to about 78 percent The model with the highest blade sweep (45 deg) and an area-ruled spinner had the highest net efficiency of 78 7 percent and at lower power loadings the efficiency exceeded 80 percent At lower Mach numbers the 30 deg swept model had the highest efficiency Values near 81 percent were obtained for the design loading at speeds to Mach 0 7 Relative noise measurements indicated that the acoustically designed 45 deg sweep model reduced the near field cruise noise by between 5 and 6 dB A R H

N79-20070*# Rockwell International Corp Los Angeles Calif
STUDY OF THE APPLICATION OF SUPERPLASTICALLY FORMED AND DIFFUSION BONDED (SPF/DC) TITANIUM STRUCTURE TO LAMINAR FLOW CONTROL (LFC) WING DESIGN
F T McQuilkin Jan 1979 101 p refs
(Contract NAS1-14566)
(NASA CR-158979 NA-77-1142) Avail NTIS HC A06/MF A01 CSCL 01A

Eighteen design concepts for a LFC wing cover using various SPF/DB approaches were developed After evaluation of producibility compatibility with LFC requirements structural efficiency and fatigue requirements three candidates were selected for fabrication of demonstration panels Included were both sandwich and stiffened semi-sandwich panels with slotted and perforated surfaces Subsequent to the evaluation of the three demonstration panels one concept was selected for fabrication of a 0 3 x 1 0 meter (12 x 42 inch) feasibility panel It was a stiffened semi sandwich panel with a slotted surface designed to meet the requirements of the upper wing cover at the maximum wing bending moment of the baseline configuration S E S

N79-20071*# National Aeronautics and Space Administration Langley Research Center Hampton Va
DETERMINATION OF STABILITY AND CONTROL PARAMETERS OF A LIGHT AIRPLANE FROM FLIGHT DATA USING TWO ESTIMATION METHODS
Vladislav Klein Mar 1979 102 p refs
(NASA-TP-1306 L-12291) Avail NTIS HC A06/MF A01 CSCL 01A

Two identification methods the equation error method and the output error method are used to estimate stability and control parameter values from flight data for a low-wing single engine general aviation airplane The estimated parameters from both methods are in very good agreement primarily because of sufficient accuracy of measured data The estimated static parameters also agree with the results from steady flights The effect of power different input forms are demonstrated Examination of all results available gives the best values of estimated parameters and specifies their accuracies Author

N79-20072*# Boeing Commercial Airplane Co Seattle Wash
REDUCTION OF COMPUTER USAGE COSTS IN PREDICTING UNSTEADY AERODYNAMIC LOADINGS CAUSED BY CONTROL SURFACE MOTIONS ANALYSIS AND RESULTS Final Report
W S Rowe J D Sebastian and J R Petrarca Mar 1979 85 p refs
(Contract NAS1-14122)
(NASA-CR-3009) Avail NTIS HC A05/MF A01 CSCL 01A

Results of theoretical and numerical investigations conducted to develop economical computing procedures were applied to an existing computer program that predicts unsteady aerodynamic loadings caused by leading and trailing edge control surface motions in subsonic compressible flow Large reductions in computing costs were achieved by removing the spanwise singularity of the downwash integrand and evaluating its effect separately in closed form Additional reductions were obtained by modifying the incremental pressure term that account for downwash singularities at control surface edges Accuracy of theoretical predictions of unsteady loading at high reduced frequencies was increased by applying new pressure expressions that exactly satisfied the high frequency boundary conditions of an oscillating control surface Comparative computer result indicated that the revised procedures provide more accurate predictions of unsteady loadings as well as providing reduction of 50 to 80 percent in computer usage costs J A M

N79-20074# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 4G ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SPLIT-FILM DATA, FAIRINGS AND SURFACE DEVICES Final Report Mar 1977 - Feb 1978
Philip F Sheridan Sep 1978 352 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)
(AD-A063000 USARTL-TR-78-23D) Avail NTIS HC A16/MF A01 CSCL 01/3

This is the seventh of the seven sub-volumes of Volume 4 containing one third octave band spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub volume deals with the effects of various fairings and also of surface devices Author (GRA)

N79-20075# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 6-C ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SINGLE FILM DATA HUBCAPS AND AIR EJECTORS Final Report 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 382 p
(Contract DAAJ02-77-C 0020 DA Proj 1L2-62209-AH-76)
(AD-A062140 USARTL-TR-78-23F-V-6-C) Avail NTIS HC A17/MF A01 CSCL 01/3

This is the third of the three volumes of Volume 6 containing one third octave band spectrographs of the model helicopter hub/rotor wake velocities derived from the single-film velocity transducer data This sub-volume deals with the effects of hub caps and air ejector systems on wake velocities Author (GRA)

N79-20076# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 7-A FREQUENCY ANALYSES OF WAKE SPLIT-FILM DATA BUILDUP TO BASELINE Final Report 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 210 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209 AH-76)
(AD A062639 USARTL-TR-78-23G-Vol-7A) Avail NTIS HC A11/MF A01 CSCL 01/3

This is the first of seven sub volumes of Volume 7 containing spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub-volume deals with the wake changes as the model is built up to baseline configuration Author (GRA)

N79-20077# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 7C FREQUENCY ANALYSES OF WAKE SPLIT-FILM DATA, SOLID HUBCAPS Final Report, 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 251 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)
(AD-A062640 USARTL-TR-78-23G-Vol-7C) Avail NTIS HC A12/MF A01 CSCL 01/3

This is the third of seven sub volumes of Volume 7 containing spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub volume deals with the effects of solid hub caps Here the cap underside is flat and does not share the upperside camber as with the open caps Author (GRA)

N79-20078# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR

HELICOPTER CONFIGURATION VOLUME 7-D FREQUENCY ANALYSES OF WAKE SPLIT-FILM DATA OPEN HUBCAPS Final Report 15 Mar 1977 - Feb 1978
Philip F Sheridan Sep 1978 400 p
(Contract DAAJ02-77-C 0020)
(AD-A062641 USARTL-TR-78-23G-Vol-7D) Avail NTIS HC A17/MF A01 CSCL 01/3

This is the fourth of seven sub volumes of Volume 7 containing spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub volume deals with the effects of various open hub caps Open caps have parallel undersides and uppersides Author (GRA)

N79-20079# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 7-E FREQUENCY ANALYSES OF WAKE SPLIT-FILM DATA AIR EJECTORS Final Report, 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 397 p
(Contract DAAJ02-77-C-0020)
(AD-A062590 USARTL-TR-78-23G-Vol-7-E) Avail NTIS HC A17/MF A01 CSCL 01/3

This is the fifth of seven sub volumes of Volume 7 containing spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub volume deals with the effects of various air ejector systems on the wake Author (GRA)

N79-20080# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 7-F FREQUENCY ANALYSES OF WAKE SPLIT-FILM DATA, AIR EJECTORS WITH HUBCAPS Final Report 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 230 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)
(AD-A062117 USARTL-TR-78-23G-Vol-7F) Avail NTIS HC A11/MF A01 CSCL 01/3

This is the sixth of seven sub volumes of Volume 7 containing spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub volume deals with the effects of air ejector systems in configurations already possessing hub caps and also effects of several wing configurations mounted variously to alter the wake Author (GRA)

N79-20081# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 7-G FREQUENCY ANALYSES OF WAKE SPLIT-FILM DATA FAIRINGS AND SURFACE DEVICES Final Report 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 344 p
(Contract DAAJ02-77-C 0020)
(AD-A062642 USARTL-TR-78-23G-Vol-7G) Avail NTIS HC A15/MF A01 CSCL 01/3

This is the seventh sub-volumes of Volume 7 containing spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub-volume deals with the effects of various fairings and also of surface devices Author (GRA)

N79-20082# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMIC OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 8-A FREQUENCY ANALYSES OF WAKE SINGLE FILM DATA BUILDUP TO BASELINE Final Report, 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 291 p refs
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)
(AD-A062254 USARTL-TR-78-23H) Avail NTIS HC A13/MF A01 CSCL 01/3

This is the first of the three volumes of Volume 8 containing frequency spectrographs of the model helicopter hub/rotor wake velocities from the single-film velocity transducer data This sub-volume deals with the wake changes as the model is built up to the baseline configuration Author (GRA)

N79-20084# McDonnell-Douglas Corp St Louis Mo
LIFT SYSTEM INDUCED AERODYNAMICS OF V/STOL AIRCRAFT IN A MOVING DECK ENVIRONMENT VOLUME 2 STATIC AND DYNAMIC JET-INDUCED FORCE AND MOMENT DATA Final Report 30 Sep 1977 - 29 Sep 1978
James H Kamman and Charles L Hall 29 Sep 1978 773 p
(Contract N62269-77-C-0365)
(AD A062097 NADC-77107-30-Vol-2) Avail NTIS HC A99/MF A01 CSCL 01/2

The propulsive lift system induced aerodynamics of multi jet V/STOL aircraft configurations were experimentally evaluated over a moving deck and at static hover conditions Several model configurations representative of advanced subsonic and supersonic V/STOL aircraft were tested Dynamic jet-induced force and moment data were obtained for heaving pitching and rolling motions of a simulated seaborne landing platform over a range of heights amplitudes and frequencies Configuration effects were assessed at both static hover and deck motion conditions including the effects of wing height fuselage contouring lift improvement devices and nozzle arrangement In addition tests were performed to separate the effects of deck motion on the fountain impingement forces Empirical procedures were defined to aid in predicting the dynamic jet-induced forces and moment variations with deck motion Configuration design and model testing guidelines for V/STOL aircraft are described Recommendations are also made for further research to provide additional information required to develop generalized prediction procedures Author (GRA)

N79 20085# Pennsylvania State Univ University Park Applied Research Lab
ACOUSTIC EFFICIENCY OF BOUNDARY LAYER TRANSITION
G C Lunchle 7 Nov 1978 16 p refs
(Contract N00017-73-C-1418)
(AD-A062171 TM-78-285) Avail NTIS HC A02/MF A01 CSCL 20/4

The radiated noise due to incompressible boundary-layer transition on an infinite rigid planar surface has been recently analyzed (ARL TM 78-204 28 July 1978) The results of that analysis are the power spectrum and directivity of the farfield sound pressure due to a unit span of transition zone flow In this note we further analyze transition zone flow noise by deriving an expression for the acoustic efficiency We compare this efficiency with the acoustic efficiency of a fully developed turbulent boundary layer and find that the radiation from the transition zone is considerably more efficient In particular for typical values of the Reynolds numbers upon which this comparison depends transition zone radiation is approximately a thousand times more efficient Author (GRA)

N79-20086# Calspan Advanced Technology Center Buffalo N Y
A STUDY OF INLET CONDITIONS FOR THREE-DIMENSIONAL TRANSONIC COMPRESSOR FLOWS Final Report, 1 Jun 1977 - 31 May 1978
William J Rae and John A Lordi Jun 1978 66 p refs
(Contract N00019-77-C-0363)
(AD A062688 CALSPAN XE-6129-A 4) Avail NTIS HC A04/MF A01 CSCL 20/4

This report contains a study of the conditions at the inlet of a transonic compressor with special reference to the formulation of these conditions in a manner suitable for flowfield computation Several candidate methods for specifying the inlet conditions are reviewed and details are given for a procedure that uses a matching between finite-difference results and linear-theory formulas at a plane upstream of the rotor Author (GRA)

N79-20087# Advisory Group for Aerospace Research and Development Paris (France)
UNSTEADY VISCOUS THIN AIRFOIL THEORY
John E Yates (Aeronautical Res Associates of Princeton Inc N J) Jan 1979 24 p refs Presented at 47th Structures and Mater Panel Meeting Florence Sep 1978
(AGARD-R-671 ISBN-92-835-1306-1) Avail NTIS HC A02/MF A01

The concept of viscous thin airfoil theory introduced is formulated for unsteady incompressible flow The theory is developed for a flat plate airfoil with no thickness boundary layer Results indicate that the viscous pressure downwash kernel function has a logarithmic singularity in contrast to the Cauchy singularity of inviscid theory It is shown by direct numerical solution that for Reynolds number greater than 1000 the viscous and inviscid results are virtually the same except in the immediate vicinity of the trailing edge The pressure loading is greater than inviscid theory would indicate and the phase of the complex loading is less than inviscid theory The effect of edge bluntness is demonstrated for the case of steady flow S E S

N79-20088# Advisory Group for Aerospace Research and Development Neuilly-Sur-Seine (France)
A COMPARISON OF PANEL METHODS FOR SUBSONIC FLOW COMPUTATION
H S Sytsma (National Aerospace Lab Amsterdam) B L Hewitt (British Aerospace Lancaster United Kingdom) and P E Rubbert (Boeing Military Airplane Development Seattle) Feb 1979 89 p refs
(AGARD-AG 241 ISBN-92 835 1312 6) Avail NTIS HC A05/MF A01

A data base for a number of relatively simple wing configurations and nacelle configurations is presented The data results were obtained from the Roberts (BAe) Spline-Neumann Program and a pilot version of the Boeing Advanced Panel-Type Influence Coefficient Method In addition results from the practical engineering type application of several methods are compared with the data solutions These comparisons suggest that of the methods considered the Boeing Advanced Panel Type Influence Coefficient Method is the most efficient in terms of accuracy/computation time ratio J M S

N79-20089*# National Aeronautics and Space Administration Langley Research Center Hampton Va
SIMULATION STUDY TO EVALUATE A CONSTANT-GROUNDSPEED APPROACH METHOD IN MODERATE AND SEVERE WIND SHEARS
Wendell W Kelley Mar 1979 51 p refs
(NASA-TM-80060) Avail NTIS HC A04/MF A01 CSCL 01C

The use of a constant-groundspeed procedure for flying final approaches in moderate and severe wind shear environments was investigated Performance was compared to results of simulated constant-airspeed approaches in identical wind profiles The simulation model was a medium twin-jet transport equipped with an autothrottle for maintaining constant groundspeed or constant airspeed For both moderate and severe wind shears the constant groundspeed approach method was shown to provide a way to more safely negotiate the shears while also providing predictable and acceptable touchdown performance Results showed airspeeds on final approach to be considerably higher using the constant groundspeed method which supplied the additional stall margin needed when tail-wind shears were encountered Throttle movements were noticeably reduced in all wind profiles when constant-groundspeed approaches were flown Touchdown conditions were practically identical for both approach methods in moderate wind shear J M S

N79-20090# National Transportation Safety Board Washington, D C
AIRCRAFT ACCIDENT REPORT NORTH CENTRAL AIRLINES INC CONVAIR 580 N4825C KALAMAZOO MUNICIPAL AIRPORT, KALAMAZOO MICHIGAN JULY 25 1978
22 Feb 1979 47 p
(NTSB-AAR-79 4) Avail NTIS HC A03/MF A01

At 0702 e d t on July 25 1978 a North Central Airlines Inc Convair 580 operating as Flight 801 crashed after takeoff from Kalamazoo Municipal Airport Kalamazoo Michigan Just as the aircraft passed V1 a bird struck the left engine and the left propeller autofeathered as the aircraft lifted off The aircraft turned to the left and flew for 1 minute 19 seconds before it crashed into a cornfield There were 40 passengers including an infant and a crew of 3 on board the aircraft One crewmember and two passengers were injured seriously The National Transportation Safety Board determined that the probable cause of this accident was the failure of the captain to follow the prescribed engine out procedures during instrument meteorological conditions which allowed the aircraft to decelerate into a flight regime from which he could not recover Contributing to the accident were inadequate cockpit coordination and discipline Author

N79-20091# National Transportation Safety Board Washington D C Bureau of Accident Investigation
AIRCRAFT ACCIDENT REPORT E S M GROUP INC CESSNA CITATION, N51MW AND NORTH CENTRAL AIRLINES, INC DC-9-30, N957N LAGUARDIA AIRPORT, FLUSHING NEW YORK 21 JUNE 1978
22 Feb 1979 18 p
(NTSB-AAR-79-3) Avail NTIS HC A02/MF A01

About 2149 e d t on June 21 1978 at La Guardia Airport Flushing New York E S M Group Inc Cessna Citation N51MW almost collided with a North Central Airlines Inc DC-9-30 N957N as the Cessna attempted to take off from runway 13 Shortly after the local controller had cleared the Cessna for takeoff the DC-9 which had been cleared by the ground controller to taxi northwest on the active runway turned on to runway 13 The pilot of the Cessna saw the DC 9 rejected the takeoff steered his airplane off the runway and avoided a collision Although there were no injuries to the occupants of either aircraft and the DC 9 was not damaged the Cessna was damaged slightly Thunderstorms throughout New York Air Route Traffic Control Center s airspace had caused air traffic delays Because of these delays the taxiways ramps and gates at La Guardia Airport were congested with aircraft The National Transportation Safety Board determined the probable cause of the incident was the failure of the ground and local controller in the La Guardia tower to effect the required coordination before using the active runway for taxiing an aircraft Also contributing to the incident was a coordination procedure which did not require the local controller to establish direct communication with the pilot of the aircraft before clearing him to use the active runway for extended taxi operations Author

N79-20092# Computer Sciences Corp Trevose Pa
ESCAPE SYSTEM TRAJECTORY SENSITIVITY ANALYSIS Final Report
John J Piacentino James F McEnerny and Gene C Eberly 1 Aug 1978 127 p
(Contract N62269-75-C 0001)
(AD-A062429 NADC-77100 40) Avail NTIS HC A07/MF A01 CSCL 01/3

Several modeling changes were performed on existing Trajectory Simulation Computer Programs to simulate the operation of various escape systems A study was conducted to identify significant input parameters and the models response to variations in the parameter values A performance envelope plot was derived for each escape system by considering large deviations in the values of these parameters from their base values Author (GRA)

N79-20093# Defence and Civil Inst of Environmental Medicine Downsview (Ontario)
PRELIMINARY INVESTIGATION OF THE SEATED HEIGHT LIMIT FOR SAFE THROUGH THE-CANOPY EJECTION FROM THE CT-114 AIRCRAFT
I Noy Nov 1978 11 p
(AD-A062403 DCIEM TR-78X37) Avail NTIS HC A02/MF A01 CSCL 06/14

In a number of ejections from the CT 114 aircraft the canopies have failed to jettison The potential for head or neck injuries exists if the helmet were to contact the canopy ahead of the canopy breaker A study was conducted to determine the seated height limit for safe through the canopy ejections and the number of pilots whose seated height exceeds the safe seated height The study involved correlating the seated heights of a number of subjects with static measurements taken in a CT 114 ejectron seat of the vertical distance between the top of their helmets and the canopy breaker The safe seated height was found to be 88 0 cm for dual visor helmets and 90 6 cm for

the helmet shell alone These limits would cut off about 75% and 45% of the pilots respectively It is recommended that further studies be conducted to determine what effect the actual shape of the canopy may have on the safe seated height and what effect the ejection forces have on pilot s seated height during the first moments of ejection Author (GRA)

N79-20094# Boeing Vertol Co Philadelphia Pa
SIMULATION CORRELATION AND ANALYSIS OF THE STRUCTURAL RESPONSE OF A CH-47A TO CRASH IMPACT Final Report Mar 1976 - Feb 1978
Y V BadriNath Aug 1978 297 p refs
(Contract DAAJ02-76-C 0015 DA Proj 1F2-62209-AH-76)
(AD-A062643 D210 11354-1) Avail NTIS HC A13/MF A01 CSCL 01/3

The purpose of this effort was to model the dynamic response of the CH-47A helicopter to a crash impact using program KRASH and to correlate the results with data from a CH 47A crash impact test An improved version of KRASH developed at Boeing Vertol was used for this purpose This report contains details of the development of a CH 47A KRASH structural model the pretest predictions and the description of the CH-47A crash impact test data Post test improvements to the structural model to improve correlation with test data are discussed Problems related to the computer program which arose during the course of the simulation and correlation efforts are discussed in detail It is concluded that the use of KRASH for simulation of the dynamic response of helicopters to crash impact is currently limited It is recommended that KRASH be improved in order for it to be useful as a design tool for the analysis of structural crashworthiness Author (GRA)

N79-20099*# Stanford Univ Calif Joint Inst for Aeronautics and Acoustics
FLAP-LAG-TORSION FLUTTER ANALYSIS OF A CONSTANT LIFE ROTOR
Inderjit Chopra Jan 1979 42 p
(Grant NsG-2317)
(NASA-CR-152244 SU-JIAA-TR-17) Avail NTIS HC A03/MF A01 CSCL 01C

The constant lift rotor (CLR) employs a control input of pitch moment to several airfoil sections which are free to pivot on a continuous spar allowing them to change their pitch to obtain the desired lift A flap lag torsion flutter analysis of a constant lift rotor blade in hover was developed The blade model assumes rigid body flap and lead-lag motions at the root hinge and each strip undergoes an independent torsional motion The results are presented in terms of root locus plots of complex eigenvalues as a function of thrust The effects of several parameters (including structural damping center of gravity and elastic axis offset from aerodynamic center compressibility pitch-lag and pitch flap coupling) on the blade dynamics are examined With a suitable combination of lag damper and pitch-flap coupling it is possible to design a constant lift rotor blade free from flutter instability Author

N79-20100*# National Aeronautics and Space Administration Langley Research Center Hampton Va
AIRCRAFT ENERGY EFFICIENCY LAMINAR FLOW CONTROL GLOVE FLIGHT CONCEPTUAL DESIGN STUDY
Andrew S Wright Jan 1979 34 p refs
(NASA-TM 80054) Avail NTIS HC A03/MF A01 CSCL 01C

A laminar flow control glove applied to the wing of a short to medium range jet transport with aft mounted engines was designed A slotted aluminum glove concept and a woven stainless steel mesh porous glove concept suction surfaces were studied The laminar flow control glove and a dummy glove with a modified supercritical airfoil ducting modified wing leading and trailing edges modified flaps and an LFC trim tab were applied to the wing after slot spacing suction parameters and compression power were determined The results show that a laminar flow control glove can be applied to the wing of a jet transport with an appropriate suction system installed S E S

N79-20101*# National Aeronautics and Space Administration Langley Research Center Hampton Va
EFFECTS OF A MILITARY CARGO POD AND TAIL FINS ON THE AERODYNAMIC CHARACTERISTICS OF A LARGE WIDE-BODY TRANSPORT MODEL
Lloyd S Jernell and Delwin R Croom Feb 1979 21 p refs
(NASA-TM-80052) Avail NTIS HC A02/MF A01 CSCL 01C

Wind tunnel tests were conducted on a 0 03 scale model of a large wide body commercial aircraft to determine the effects on the static aerodynamic characteristics resulting from the attachment of a belly pod for the long range deployment of outsize military equipment The effectiveness of horizontal-tip fins in augmenting directional stability was investigated At a test Reynolds number of 1 08 x 1 000 000 the addition of the pod results in an increase in total drag of approximately 20 percent Trim drag due to the pod is very small Although the pod produces a significant decrease in directional stability the addition of the tip fins restores some of the stability particularly at the lower angles of attack S E S

N79-20102*# National Aeronautics and Space Administration Washington D C
ICING TESTING IN THE LARGE MODANE WIND TUNNEL ON FULL-SCALE AND REDUCED SCALE MODELS
F Charpin and G Fasso Mar 1979 20 p refs Transl into ENGLISH from Aeronaut Astronaut (France) no 38 1972 p 23 31 Presented at Conf on Protection Against Icing London 10 May 1972 Original language document was announced as A73-20244 Transl by Kanner (Leo) Associates Redwood City Calif
(Contract NASw-3199)
(NASA-TM 75373) Avail NTIS HC A02/MF A01 CSCL 01C

Icing tests on full scale models of parts of aircraft (wings tailplanes radome) equipped with actual de-icing systems were carried out in the large Modane wind tunnel of ONERA For studying icing on the Concorde it was necessary to use a 1/6 scale half model The equations governing the relevant parameter ratios to obtain reasonably good similitude water catching and ice accretion are recalled Despite the inherent limitations of this particular kind of testing i e the impossibility of duplicating both the Mach and Reynolds conditions for the main flow pattern it is possible to obtain on a reduced scale model a reasonably good representation of icing cloud catching and of the shape of resulting ice accretion Author

N79-20103*# Washington Univ St Louis Mo School of Engineering and Applied Science
THE ROLE OF ROTOR IMPEDANCE IN THE VIBRATION ANALYSIS OF ROTORCRAFT PART 4 Final Report
Kurt H Hohenemser Jun 1978 38 p refs Prepared for Army Aviation Res and Develop Command Moffett Field Calif
(Contract NAS2-7613)
(NASA-CR-152261) Avail NTIS HC A03/MF A01 CSCL 01C

A method for a strongly idealized case of vertical excitation and for rolling and pitching moment excitation of a four bladed hingeless rotor on an up focussing flexible mount is developed The aeroelastic rotor impedances are computed directly with a finite blade element method that includes aerodynamics The rotor impedance matrix for three or more blades is determined from the root moment impedance for a single blade by a simple multiblade transformation rule Force and moment amplitudes transferred from the rotor to support are found to be critically dependent on the support dynamics S E S

N79-20104*# Grumman Aerospace Corp Bethpage N Y
VALIDATION OF SCRAMJET EXHAUST SIMULATION TECHNIQUE AT MACH 6 Final Report
H B Hopkins W Konopka and J Leng Washington NASA Mar 1979 101 p refs
(Contract NAS1-14152)
(NASA-CR 3003 RE-547) Avail NTIS HC A06/MF A01 CSCL 01C

Current design philosophy for hydrogen fueled scramjet-powered hypersonic aircraft results in configurations with strong couplings between the engine plume and vehicle aerodynamics The experimental verification of the scramjet exhaust simulation is described The scramjet exhaust was reproduced for the Mach 6 flight condition by the detonation tube simulator The exhaust

flow pressure profiles and to a large extent the heat transfer rate profiles were then duplicated by cool gas mixtures of Argon and Freon 13B1 or Freon 12 The results of these experiments indicate that a cool gas simulation of the hot scramjet exhaust is a viable simulation technique except for phenomena which are dependent on the wall temperature relative to flow temperature G Y

N79-20105# Lockheed-California Co Burbank
FORMULAS FOR TAKEOFF PERFORMANCE P3-A B AND C AIRPLANES Final Report
Joseph G Carrillo and William M Purdy 27 Jul 1978 32 p refs
(Contract N00014-77-C 0461)
(AD-A062290 LR-28461) Avail NTIS HC A03/MF A01 CSCL 01/2

The increase in program steps to more than 200 and larger memory storage of handheld computers appears to make practicable their use in preflight planning of military missions by flight crews Such application would provide greater accuracy and enhance efficient utilization of airplane capability Contract No N00014-77-C-0461 authorized development of formulas to calculate takeoff field length requirements and pertinent airspeeds and powerplant performance to test the feasibility of this application This report contains formulas for the performance items authorized by the contract It is recommended that they be programmed for use with a hand-held computer and that computer solutions be evaluated for flight planning for service missions of P-3 airplanes Author (GRA)

N79-20106# Naval Surface Weapons Center Dahlgren Va
A COMPUTER MODEL FOR DETERMINING WEAPON RELEASE PARAMETERS FOR A HELICOPTER IN NON-ACCELERATED FLIGHT Final Report
R P Hennis and B W McCormick Oct 1978 73 p refs
(AD-A062155 NSWC/DL-TR-3823) Avail NTIS HC A04/MF A01 CSCL 16/1

A mathematical model capable of computing flight path and orientation data for helicopters having a single main rotor and a vertical tail rotor is presented The model calculates power level and control angles in steady (trimmed) flight for ascending level or descending flight paths Provisions are included for simulating a fixed wing auxiliary thrust and a movable horizontal tail whose incidence angle is linked to the main rotor longitudinal cyclic control The model is coded in Fortran Extended to run on the CDC 6700 Computer system Output from this model is used in the generation of aiming data for the delivery of unguided ordnance Author (GRA)

N79-20107# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
OPTIMUM CRUISE PERFORMANCE Final Technical Report Jun - Aug 1977
Nguyen X Vinh Nov 1978 130 p refs
(AD-A062607 AFFDL-TR-78-131) Avail NTIS HC A07/MF A01 CSCL 01/2

This report considers the cruise performance of a jet-propelled aircraft at high speed The two problems of cruise with maximum range and with maximum endurance are analyzed In each problem for any given aircraft aerodynamics and engine characteristics the equation for determining the optimum Mach number for cruise is derived For maximum range there exists an optimum cruise altitude For the maximum endurance problem the effect of the altitude on performance is negligible It is shown that in both problems constant Mach number cruise is a satisfactory flying technique In the true optimum solution the optimum Mach number slowly decreases along the flight path In this case the singular thrust control is obtained explicitly as function of the Mach number Author (GRA)

N79-20108# General Electric Co Schenectady N Y
ANALYSIS AND CALCULATIONS OF LIGHTNING INTERACTIONS WITH AIRCRAFT ELECTRICAL CIRCUITS Final Report 16 May 1976 - 21 Feb 1978
F A Fisher Aug 1978 398 p
(Contract F33615-76-C-3122)
(AD-A062606 SRD-78-044 AFFDL-TR-78-106) Avail NTIS HC A17/MF A01 CSCL 01/3

This report documents the results of a study performed to evaluate the indirect effects of lightning strikes - specifically induced voltages - on the electrical systems of aircraft Numerical methods for evaluating the fields produced by lightning currents flowing the skin of the aircraft are presented as a first analytical step Additional numerical methods for computing the voltages induced in wiring systems by the fields evaluated in the first step are also presented as are recommendations on the direction of further study Author (GRA)

N79-20109# Dynamics Research Corp Wilmington Mass Systems Div
AN ANALYSIS OF FUEL CONSERVING OPERATIONAL PROCEDURES AND DESIGN MODIFICATIONS FOR BOMBER/TRANSPORT AIRCRAFT VOLUME 2 Final Report 7 Jun 1976 - 7 Jul 1978
Romesh K Aggarwal Jul 1978 508 p refs
(Contract F33615-76-C-3104)
(AD-A062609 R-247U AFFDL-TR-78-96-Vol-2) Avail NTIS HC A22/MF A01 CSCL 01/3

Various proposed improvements in the design and operational procedures for bomber/transport aircraft are evaluated The evaluation is performed in terms of the estimated savings in fuel consumption and in Direct Operating Cost (DOC) As an aid in the evaluation of design modifications graphs of fuel and DOC savings as a function of the design parameters are developed These graphs are based on actual mission trajectory data rather than some typical trajectory profile The actual mission data is presented in terms of histograms which provide statistical information concerning altitude air speed take off weight landing weight and mission time Separate analyses are performed on the following aircraft the B-52G the B-52H the KC-135 the C-141 the C-130 and the C-5A Author (GRA)

N79-20110# Texas Technological Coll Lubbock Dept of Civil Engineering
DYNAMICS OF COMPLEX STRUCTURES-ANALYSIS AND EXPERIMENT DAMAGED AIRCRAFT STABILATORS Final Technical Report, 15 Jan 1977 - 15 Jul 1978
Jimmy H Smith and M Lynn Beascon Nov 1978 88 p refs
(Grant AF-AFOSR-3231-77)
(AD-A062691 AFOSR-78-1621TR) Avail NTIS HC A05/MF A01 CSCL 01/3

This report presents the results of an experimental and analytical program employed to determine the effect that damage to a horizontal stabilator has on structural characteristics such as stiffness natural frequencies and damping A simplified method of computing the change in the fundamental frequency as damage increases is also developed Author (GRA)

N79-20111*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
SURVEY OF HELICOPTER CONTROL/DISPLAY INVESTIGATIONS FOR INSTRUMENT DECELERATING APPROACH
J Victor Lebacqz Mar 1979 133 p refs
(NASA-TM-78565 A-7751) Avail NTIS HC A07/MF A01 CSCL 01D

Control display requirements for helicopters conducting decelerating approaches in the terminal area under instrument meteorological conditions were surveyed The programs are organized on the basis of the control augmentation concepts that were considered and the results are summarized and compared Nine control display combinations are hypothesized as possible candidates for future ground and in-flight investigation Specific guidelines for the guidance relationship control characteristics and display presentation concepts are given SES

N79-20112*# Aerospace Systems Inc Burlington Mass
DISPLAY/CONTROL REQUIREMENTS FOR AUTOMATED VTOL AIRCRAFT Final Report
W C Hoffman D L Kleinman and L R Young Oct 1976 161 p refs

(Contract NAS1-13653)
(NASA-CR-158905 ASI-TR-76 39) Avail NTIS HC A04/MF A01 CSCL 01D

A systematic design methodology for pilot displays in advanced commercial VTOL aircraft was developed and refined The analyst is provided with a step by-step procedure for conducting conceptual display/control configurations evaluations for simultaneous monitoring and control pilot tasks The approach consists of three phases formulation of information requirements configuration evaluation and system selection Both the monitoring and control performance models are based upon the optimal control model of the human operator Extensions to the conventional optimal control model required in the display design methodology include explicit optimization of control/monitoring attention simultaneous monitoring and control performance predictions and indifference threshold effects The methodology was applied to NASA s experimental CH-47 helicopter in support of the VALT program The CH-47 application examined the system performance of six flight conditions Four candidate configurations are suggested for evaluation in pilot-in-the-loop simulations and eventual flight tests A R H

N79 20114*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
PARAMETRIC PERFORMANCE OF A TURBOJET ENGINE COMBUSTOR USING JET A AND A DIESEL FUEL
Helmuth F Butze and Francis M Humenik Mar 1979 44 p refs
(NASA-TM-79089 E-9913) Avail NTIS HC A03/MF A01 CSCL 21E

The performance of a single can JT8D combustor was evaluated with Jet A and a high aromatic diesel fuel over a parametric range of combustor-inlet conditions Performance parameters investigated were combustion efficiency emissions of CO unburned hydrocarbons and NOx as well as liner temperatures and smoke At all conditions the use of diesel fuel instead of Jet A resulted in increases in smoke numbers and liner temperatures gaseous emissions on the other hand did not differ significantly between the two fuels Author

N79-20115# National Aviation Facilities Experimental Center Atlantic City N J
EMISSION SAMPLE PROBE INVESTIGATION OF A MIXED FLOW TF30 TURBOFAN ENGINE Final Report, Jan 1974 - Jul 1977
Gerald R Slusher Nov 1978 90 p refs
(FAA NA-78-3 FAA-RD-78-89) Avail NTIS HC A05/MF A01

The emissions in the exhaust plume of mixed flow TF30 turbofan engine were investigated to optimize the shape size and location of fixed probes for acquiring representative emission samples Traverse measurements of 121 points over the exhaust nozzle were accomplished with the sample points located on a 2-inch square grid The average emission levels contours and profile distributions were determined Exhaust emissions were measured with four mixing multihole averaging probes in the core exhaust the engine turbine discharge pressure probes and an experimental diamond probe design Results indicate that the 12 point diamond probe provides representative exhaust samples from mixed-flow TF30 engine M M M

N79-20116*# Pratt and Whitney Aircraft Group East Hartford Conn Commercial Products Div
JT8D AND JT9D JET ENGINE PERFORMANCE IMPROVEMENT PROGRAM TASK 1 FEASIBILITY ANALYSIS Final Report, Feb - Dec 1977
W O Gaffin and D E Webb Apr 1979 227 p refs
(Contract NAS3-20630)
(NASA-CR-159449 PWA-5518-38) Avail NTIS HC A11/MF A01 CSCL 21E

JT8D and JT9D component performance improvement concepts which have a high probability of incorporation into production engines were indentified and ranked An evaluation method based on airline payback period was developed for the purpose of identifying the most promising concepts The method used available test data and analytical models along with conceptual/preliminary designs to predict the performance improvements weight installation characteristics cost for new production and retrofit maintenance cost and qualitative characteristics of candidate concepts These results were used to arrive at the concept payback period which is the time required for an airline to recover the investment cost of concept implementation G Y

N79-20118*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
TESTS OF NASA CERAMIC THERMAL BARRIER COATING FOR GAS-TURBINE ENGINES
Curt H Liebert 1979 10 p refs Presented at the Intern Conf on Met Coatings San Diego Calif 23-27 Apr 1979
(NASA-TM-79116 E 9846-1) Avail NTIS HC A02/MF A01 CSCL 21E

A two layer thermal barrier coating system with a bond coating of nickel-chromium aluminum-yttrium and a ceramic coating of yttria-stabilized zirconia was tested for corrosion protection thermal protection and durability Full-scale gas turbine engine tests demonstrated that this coating eliminated burning melting and warping of uncoated parts During cyclic corrosion resistance tests made in marine diesel fuel products of combustion in a burner rig the ceramic cracked on some specimens Metallographic examination showed no base metal deterioration S E S

N79-20119# Naval Research Lab Washington D C
STRESS INTENSITY FACTORS IN THIRD-STAGE FAN DISK OF THE TF-30 TURBINE ENGINE Final Report
R J Sanford and J W Dally 15 May 1978 26 p refs
(AD-A062103 AD E000260 NRL-8202) Avail NTIS HC A03/MF A01 CSCL 21/5

A photoelastic determination of the mixed-mode stress-intensity factors in a scale model of the third-stage fan disk of the TF-30 turbine engine was performed A series of 23 tests were conducted to obtain isochromatic fringe patterns at the tip of a simulated crack as it was incrementally extended through the lug along the observed failure path The isochromatic fringe patterns were analyzed by employing a newly developed method which permits determination of both opening and shearing mode stress-intensity factors K sub I and K sub II in the presence of far-field stresses sigma sub ox Although both K sub I and K sub II varied as the crack extended from its initiation point to its turning point the effective stress intensity factor K sub eff equal to the square root of the sum of the squares of K sub I and K sub II remained essentially constant over most of the length of the fracture path After the crack turns the propagation is predominantly mode I and the value of K sub eff increases dramatically with increasing crack length Author (GRA)

N79-20121# Minnesota Univ Minneapolis Dept of Mechanical Engineering
HEAT TRANSFER PROBLEMS IN ADVANCED GAS TURBINES FOR NAVAL APPLICATIONS Annual Progress Report 1 Sep 1977 - 30 Nov 1978
E R Eckert R J Goldstein and E M Sparrow Nov 1978 34 p
(Contract N00014-76 C 0246 NR Proj 097-383)
(AD A062866) Avail NTIS HC A03/MF A01 CSCL 21/5

The report covers heat exchanger studies stressing measurements of local heat transfer coefficients Direct heat transfer measurements were performed and a method was also used which was based on the heat and mass transfer analog Local ablation rates were obtained on a model covered with napthalene and heat transfer rates were deduced from these through the analogy Measurements of the turbulence intensity in a gas stream leaving a combustion chamber were also reported Author (GRA)

N79-20122# Rockwell International Corp Columbus Ohio Aircraft Div
COMPUTER-AIDED DESIGN STUDY OF HYPERMIXING NOZZLES Final Report 19 Oct 1977 - 19 Jul 1978
L A Mefferd and P M Bevilaqua 19 Jul 1978 85 p refs
(Contract N00019-77-C-0527)
(AD-A062374 NR78H-91) Avail NTIS HC A05/MF A01 CSCL 21/5

A combination of computer analysis and scale model testing was utilized to compare the entrainment rates of a variety of jet mixer nozzles The objective of the study was to develop a nozzle which would increase the performance of thrust augmenting ejectors on V/STOL aircraft Various multi-lobe and vortex generating nozzles were devised and studied The spreading of the jet from each nozzle was predicted by calculating a finite-difference solution of Reynolds equations for the three dimensional flow field A two-equation turbulence kinetic energy model was used for closure Limited experimental testing was then performed to verify the predicted trends It was concluded that increasing the length of the nozzle lobes produces the greatest increase in thrust augmentation and that an alternating slot nozzle yields the greatest augmentation for a given lobe size Author (GRA)

N79-20123# Cranfield Inst of Technology Bedfordshire (England) School of Mechanical Engineering
UNSTEADY EFFECTS OF CIRCUMFERENTIAL PRESSURE DISTORTED INLET FLOWS IN COMPRESSORS Progress Report 15 Apr - 14 Oct 1978
R E Peacock Nov 1978 39 p
(Grant AF-AFOSR 3305-77)
(AD-A062550 AFOSR-78-1629TR PR-3) Avail NTIS HC A03/MF A01 CSCL 21/5

Using custom designed and developed rotor borne instrumentation rotating stall phenomena are examined in lightly loaded single-stage compressor Two different classes of rotating stall are identified and of different rotational frequency One propagates from the blade loading edge and the other from the blade trailing edge Author (GRA)

N79-20125# Williams Research Corp Walled Lake Mich
LOW COST EXPENDABLE ENGINE Final Technical Report, Apr 1976 - Mar 1978
C A Huben and B L Metsker Wright-Patterson AFB Ohio AFAPL Mar 1978 119 p
(Contract F33615-76-C-2123 AF Proj 3066)
(AD-A062864 AFAPL-TR-78-33) Avail NTIS HC A06/MF A01 CSCL 21/5

A low cost expendable turbojet engine in the 200 pound thrust class was fabricated and tested The design manufacturing and inspection concepts of the program resulted in the achievement of a projected engine cost of $2883 each in lots of 1000 engines in terms of 1975 economics Problems solved during the compressor rig testing and engine tune-up testing are discussed The results of the engine demonstration testing both at sea level static conditions and under a simulated Mn 0 7 condition are presented Author (GRA)

N79-20126# Stevens Inst of Tech Hoboken, N J Dept of Mechanical Engineering
RESEARCH ON THE FLUTTER OF AXIAL TURBOMACHINE BLADING
Fernando Sisto and Richard Rossin Nov 1978 31 p
(Contract N00014-76 C-0540 NR Proj 094-363)
(AD-A063102 NE-RT-78004) Avail NTIS HC A03/MF A01 CSCL 20/4

Typical aerodynamic moment and free flutter measurements are presented for thin airfoils in an annular cascade For moment measurements the parameters of significance were mean incidence angle interblade phase angle and amplitude of oscillation Since measurements take the form of a continuous record of moment versus angular position the symbolic name moment loops are used For the free flutter measurements the parameters of interest were stagger angle incidence angle torsional amplitude and reduced frequency The characteristics of the experimental data are discussed and comparison is made with earlier tested thick blades Author (GRA)

N79-20127# Advisory Group for Aerospace Research and Development Paris (France)
GUIDE TO IN-FLIGHT THRUST MEASUREMENT OF TURBOJETS AND FAN ENGINES
Jan 1979 202 p refs
(AGARD-AG-237 ISBN-92-835-1304 5) Copyright Avail NTIS HC A10/MF A01

Topics include fundamentals of thrust measurement in flight propulsion system thrust and drag book-keeping thrust expressions methodology and options error assessment and control and instrumentation

N79-20128# Advisory Group for Aerospace Research and Development Paris (France)
FUNDAMENTALS OF THRUST MEASUREMENT IN FLIGHT
In its Guide to In-Flight Thrust Measurement of Turbojets and Fan Engines Jan 1979 p 19-25

Avail NTIS HC A10/MF A01

The basic requirement for separating the airframe from the engine in aircraft propulsion performance assessment is presented The planning and management of the overall test program is discussed and the required procedure is summarized SES

N79-20129# Advisory Group for Aerospace Research and Development Paris (France)
PROPULSION SYSTEM THRUST AND DRAG BOOK-KEEPING
In its Guide to In-Flight Thrust Measurement of Turbojets and Fan Engines Jan 1979 p 27-61

Avail NTIS HC A10/MF A01

A consistent and standardized structure of definitions for the various components of thrust and drag is presented The power plant and the division of technical responsibilities for the parts of the power plant are discussed Definition of terms used in a book keeping system is recommended The items which should appear in the book-keeping system were examined Wind tunnel tests needed to define the thrust/drag components and mutual interference effects are described The prediction of performance and flight test analysis were studied SES

N79-20130# Advisory Group for Aerospace Research and Development Paris (France)
THRUST EXPRESSIONS, METHODOLOGY AND OPTIONS
In its Guide to In-flight Thrust Measurement of Turbojets and Fan Engines Jan 1979 p 63-118

Avail NTIS HC A10/MF A01

Methods for determining engine standard gross and net thrust which directly or indirectly form the basis of virtually all procedures for evaluating thrust in flight are presented The methods include brochure gas generators swinging probe trunnion thrust and engine calibration conditions SES

N79-20131# Advisory Group for Aerospace Research and Development Paris (France)
ERROR ASSESSMENT AND CONTROL
In its Guide to In-Flight Thrust Measurement of Turbojets and Fan Engines Jan 1979 p 119-173

Avail NTIS HC A10/MF A01

Mathematical models are used to describe the properties of error distributions to enable the uncertainty of various results to be calculated Thrust in flight experiment to identify methods of high validity to eliminate mistakes and to assess and control errors is presented SES

N79-20132# Advisory Group for Aerospace Research and Development Paris (France)
INSTRUMENTATION
In its Guide to In Flight Thrust Measurement of Turbojets and Fan Engines Jan 1979 p 175-198 refs

Avail NTIS HC A10/MF A01

Systems design design methods for reducing error methods for reducing error in specific measurements cost effectiveness in instrumentation and properties of an accurate system of instrumentation are presented SES

N79-20133*# Analytic Sciences Corp Reading Mass
MODERN DIGITAL FLIGHT CONTROL SYSTEM DESIGN FOR VTOL AIRCRAFT
John R Broussard Paul W Berry and Robert F Stengel Hampton Va NASA Mar 1979 250 p refs
(Contract NAS1-14358)
(NASA CR-159019) Avail NTIS HC A11/MF A01 CSCL 01D

Methods for and results from the design and evaluation of a digital flight control system (DFCS) for a CH 47B helicopter are presented The DFCS employed proportional integral control logic to provide rapid precise response to automatic or manual guidance commands while following conventional or spiral descent approach paths It contained altitude- and velocity-command modes and it adapted to varying flight conditions through gain scheduling Extensive use was made of linear systems analysis techniques The DFCS was designed using linear optimal estimation and control theory and the effects of gain scheduling are assessed by examination of closed loop eigenvalues and time responses J A M

N79-20134*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif
STABILITY AND CONTROL DERIVATIVE ESTIMATES OBTAINED FROM FLIGHT DATA FOR THE BEECH 99 AIRCRAFT
Russel R Tanner and Terry D Montgomery Apr 1979 38 p refs
(NASA-TM-72863 H-1081) Avail NTIS HC A03/MF A01 CSCL 01C

Lateral directional and longitudinal stability and control derivatives were determined from flight data by using a maximum likelihood estimator for the Beech 99 airplane Data were obtained with the aircraft in the cruise configuration and with one third flap deflection The estimated derivatives show good agreement with the predictions of the manufacturer Author

N79 20135*# National Aeronautics and Space Administration Langley Research Center Hampton Va
A PITCH ATTITUDE STABILIZATION SYSTEM UTILIZING ENGINE PRESSURE RATIO FEEDBACK SIGNALS Patent Application
Wendell W Kelley inventor (to NASA) Filed 28 Feb 1979 14 p
(NASA-Case-LAR-12562-1 US-Patent-Appl-SN-015995) Avail NTIS HC A02/MF A01 CSCL 01C

The invention relates to a pitch attitude stabilization system in which engine pressure ratio (EPR) signals are used to cancel pitching moments due to changes in thrust The invention consists essentially of aircraft engine instrumentation 15 that generates an EPR signal In a first embodiment of the invention the EPR signal is compared to a reference EPR signal 46 by means of a summing device 47 The resulting difference signal is multiplied by a constant K sub EPR to form a control signal which cancels pitching moments due to changes in thrust This control signal is added to the other pitch control signals by a summing device 32 NASA

N79-20136*# National Aeronautics and Space Administration Langley Research Center Hampton Va
A VELOCITY VECTOR CONTROL SYSTEM AUGMENTED WITH DIRECT LIFT CONTROL Patent Application
Henry F Tisdale Sr (Tisdale Henry F Sr Oakhurst N J) and Wendell W Kelley inventors (to NASA) Filed 28 Feb 1979 16 p Sponsored by NASA
(NASA-Case-LAR-12268-1 US Patent-Appl-SN-015996) Avail NTIS HC A02/MF A01 CSCL 01C

A pilot controlled stability control system is described that employs direct lift control (spoiler control) with elevator control to control the flight path angle of an aircraft A computer on the aircraft generates an elevator control signal and a spoiler control signal using a pilot controlled pitch control signal and pitch rate vertical velocity roll angle groundspeed, engine pressure ratio and vertical acceleration signals which are generated on the aircraft The direct lift control by the aircraft spoilers improves the response of the aircraft flight path angle and provides short term flight path stabilization against environmental disturbances NASA

N79-20137# Advisory Group for Aerospace Research and Development Paris (France)
EXCITATION AND ANALYSIS TECHNIQUE FOR FLUTTER TESTS
G Haidl (Messerschmitt Boelkow-Blohm GmbH Munich) and M Steininger (Messerschmitt-Boelkow-Blohm GmbH Munich) Jan 1979 31 p refs Presented at 47th Structures and Mater Panel Meeting Florence Sep 1978
(AGARD-R-672 ISBN 92 835-1309 6) Avail NTIS HC A03/MF A01

Excitation methods applied recently for flight flutter testing were surveyed Examples of excitation by frequency sweep pseudo random harmonic oscillation and control feedback technique are given and their effectiveness and adaption to digital processing is discussed Experience with generating aerodynamic forces by control-surfaces or additional vanes is presented The digital analysis of flight flutter test data is described Recommendations for selection of analysis parameters and how to avoid errors due to digital processing are given For data evaluation in flight flutter tests the autopower spectrum and transfer and coherence function are used Errors and effects of digital blockwise computation and analysis procedures like block overlapping windowing averaging or curve fitting are demonstrated The filter correlation and the modal analysis technique are applied for mode separation and damping evaluation based on the above mentioned functions Practical experiences and examples from wind tunnel flight and laboratory tests are discussed An on line computer program for realtime calculation of resonance frequencies and damping factors is presented S E S

N79-20138# Advisory Group for Aerospace Research and Development Neuilly-Sur-Seine (France)
AGARD FLIGHT TEST INSTRUMENTATION SERIES VOLUME 9 AEROELASTIC FLIGHT TEST TECHNIQUES AND INSTRUMENTATION
J W G vanNunen ed and G Piazzoli ed Feb 1979 50 p
(AGARD-AG-160 Vol 9 ISBN 92-835-1311 8) Avail NTIS HC A03/MF A01

The flight test instrumentation for determining the flutter behavior of an aircraft is presented The mechanism of flutter is reviewed and the following items are discussed (1) requirements which the type of excitation should obey in order to enable the determination of the flutter characteristics (2) possible means of excitation (3) appropriate instrumentation and (4) data analysis procedures S E S

N79-20139# Advisory Group for Aerospace Research and Development Paris (France)
TECHNICAL EVALUATION REPORT ON THE FLIGHT MECHANICS PANEL SYMPOSIUM ON STABILITY AND CONTROL
Charles R Chalk (Calspan Corp Buffalo N Y) Jan 1979 18 p ref Symp held at Ottawa 25-28 Sep 1978
(AGARD-AR-134 ISBN-92-835-1308 8) Avail NTIS HC A02/MF A01

Some of the possibilities for matching control systems and characteristics to aircraft mission requirements were examined The technology of active control concepts and CCV to operational aircraft is reported Questions concerning the operational needs cost effectiveness reliability and maintenance of the active control concepts and CCV are discussed S E S

N79-20140*# Spectron Development Labs Inc Costa Mesa Calif
FEASIBILITY STUDY OF TRANSIT PHOTON CORRELATION ANEMOMETER FOR AMES RESEARCH CENTER UNITARY WIND TUNNEL PLAN Final Report
W T Mayo Jr and A E Smart 7 Feb 1979 86 p refs Original contains color illustrations
(Contract NAS2-10072)
(NASA-CR 152238 SDL-79 6397) Avail NTIS HC A05/MF A01 CSCL 14B

A laser transit anemometer measured a two-dimensional vector velocity using the transit time of scattering particles between two focused and parallel laser beams The objectives were (1) the determination of the concentration levels and light scattering efficiencies of naturally occurring submicron particles in the NASA/Ames unitary wind tunnel and (2) the evaluation based on these measured data of a laser transit anemometer with digital correlation processing for nonintrusive velocity measurement in this facility The evaluation criteria were the speeds at which point velocity measurements could be realized with this technique (as determined from computer simulations) for given accuracy requirements J A M

N79-20141# Washington Univ Seattle Dept of Aeronautics and Astronautics
IMPROVEMENT OF FLOW QUALITY AT THE UNIVERSITY OF WASHINGTON LOW SPEED WIND TUNNEL
Shojiro Shindo William H Rae Jr Yokio Aoki (Boeing Commerical Airplane Co Seattle) and Eugene G Hill (Boeing Commercial Airplane Co Seattle) 17 Aug 1978 35 p refs Presented at AIAA 10th Aerodyn Testing Conf San Diego Calif 19 21 Apr 1978 Backup document for AIAA Synoptic Improvement of Flow Quality at the University of Washington Subsonic Wind Tunnel scheduled for publication in Journal of Energy May-June 1979
(AIAA-Paper-78-815) Avail NTIS HC A03/MF A01

A method for improving flow quality in an 8 x 12 foot wind tunnel was developed The capability to measure and interpret small changes in configuration was limited by the uniformity of flow in the test media The improvements which resulted in a more uniform flow reduction of power and turbulence level and its effect on aerodynamic test data are presented J A M

N79-20142*# Southampton Univ (England) Dept of Aeronautics and Astronautics
STUDIES OF SELF STREAMLINING WIND TUNNEL REAL AND IMAGINARY FLOWS Semiannual Progress Report Jan - Jul 1978
S W D Wolf and M J Goodyer 1978 76 p refs
(Grant NsG-7172)
Avail NTIS HC A05/MF A01 CSCL 14B

Testing in the low speed flexible walled tunnel in an effort to explain the reasons for data discrepancies at high angles of attack are presented Automated transonic test sections were developed The flexible walled tunnel was used in a new operating mode to a generated curved flow around the airfoil allowing the extraction of purely rotary derivatives Some straight wall low speed pressure data for wall and model which is used for checking interference correction methods were reported Computer software which includes an old streamlining algorithm and a prediction algorithm was examined S E S

N79-20143# ARO Inc Arnold Air Force Station Tenn
COMPUTERIZED HEAT-TRANSFER AND STRESS ANALYSIS OF WIND TUNNEL METAL THROAT LINERS Final Report, 2 Jun 1977 - 22 Jun 1978
Dennis T Akers AEDC Nov 1978 89 p refs
(AD-A062318 AEDC-TR-78-54) Avail NTIS HC A05/MF A01 CSCL 14/2

This study presents a computerized approach to analyze the structural integrity of wind tunnel coverging-diverging nozzles or liners In order to maintain liner configurations to produce accurate test conditions the liners must be externally cooled usually with water Thermal gradients are set up in the liner and an analysis must be made to ensure adequate design One of the most difficult problems in analyzing the liner is determining the airside forced convection heat transfer coefficient The main reason it is so difficult is due to the boundary layer that develops along the contour of the liner Sivells ARO Inc derived programmed and experimentally checked a method for calculating the turbulent boundary-layer properties in the supersonic section of a liner Using the results from Sivells program and an iterative radial heat balance one can write a subroutine called HEAT to determine (1) The thermal gradient through the thickness of the liner (2) The temperature profile along the length of the liner and (3) The total stresses at any point in the liner Included in the subroutine is a method for determining the same three conditions for the subsonic section of the liner Author (GRA)

N79-20144# Calspan Corp Buffalo N Y
RESEARCH ON ADAPTIVE WALL WIND TUNNELS Final Report May 1976 - Nov 1977
Robert J Vidal and J C Rickson Jr Nov 1978 66 p refs
(Contract-F40600-76-C-0011)
(AD-A062110 CALSPAN-RK-5934-A-1 AEDC-TR-78-36)
Avail NTIS HC A04/MF A01 CSCL 20/4

The objective of this research was to investigate the utility of the Calspan self-correcting wind tunnel for minimizing or eliminating wall interference effects in two dimensional transonic flows when shock waves from the test model extend to the tunnel walls This report summarizes the experimental research performed with two-dimensional airfoils in the Calspan self correcting wind tunnel and the theoretical research accomplished in support of the experiments The experiments were performed with airfoil models having 4% and 6% solid blockage The initial experiments with the 6%-blockage model were devoted to determining a practical mode of operation when shock waves from the model extend to the wall The most practical model is to use wall control to obtain the desired distribution of longitudinal velocity components for subcritical walls The Mach number is then increased and the wall control is readjusted sequentially until the desired test condition is achieved At the high Mach numbers of interest however the available wall control was limited locally and tunnel system changes were required A method is reported for analyzing self correcting wind tunnels with porous walls GRA

N79-20145# Transportation Research Board Washington D C
RESEARCH IN AIRPORT PAVEMENTS
1978 124 p refs Conf held at Atlanta 15-17 Nov 1976 sponsored by FAA
(PB 289432/7 TRB/SR-175 ISBN 0 309-02800 0
LC-78-10924) Avail NTIS HC A06/MF A01 CSCL 01E

At the request of the Federal Aviation Administration the Transportation Research Board conducted a conference on research in airport pavements Research results that can now be implemented are in the following areas (a) The pavement aircraft compatibility study provides a basis for trade offs between aircraft and pavement design (b) aircraft distribution on airport pavements for design and rehabilitation purposes (c) mix design and construction procedures for fibrous concrete to permit its use where appropriate (d) mix design and construction procedures for porous friction courses (e) suitable equipment and procedures for measuring pavement unevenness and (f) statistical quality control and quality assurance procedures for use in pavement construction and rehabilitation GRA

N79 20166*# National Aeronautics and Space Administration Wallops Station Wallops Island Va
A NEW DIMENSION WALLOPS ISLAND FLIGHT TEST RANGE THE FIRST FIFTEEN YEARS
Joseph Adams Shortal Dec 1978 784 p refs
(Contract NAS6-1364)
(NASA-RP-1028) Avail NTIS HC A99/MF A01 CSCL 14B

A record of the first fifteen years (1945 1959) of research and development tests that were performed at Wallops Island is presented It begins with the events that led to the establishment of the National Advisory Committee for Aeronautics flight test range on Wallops Island to the first year as a part of the National Aeronautics and Space Administration F O S

N79-20174*# Science Applications Inc Huntsville Ala
TURBULENCE SIMULATION MECHANIZATION FOR SPACE SHUTTLE ORBITER DYNAMICS AND CONTROL STUDIES
Frank B Tatom and Richard L King Dec 1977 53 p refs
(Contract NAS8-31173)
(NASA-CR-161194 SAI-78-766-HU) Avail NTIS HC A04/MF A01 CSCL 22B

The current version of the NASA turbulent simulation model in the form of a digital computer program TBMOD is described The logic of the program is discussed and all inputs and outputs

are defined An alternate method of shear simulation suitable for incorporation into the model is presented The simulation is based on a von Karman spectrum and the assumption of isotropy The resulting spectral density functions for the shear model are included A R H

N79-20175# ARO Inc Arnold Air Force Station Tenn
EFFECTS OF VERTICAL TAIL FLEXIBILITY ON THE AERODYNAMIC CHARACTERISTICS OF A 0 03-SCALE NASA SPACE SHUTTLE ORBITER AT MACH NUMBERS FROM 0 90 TO 1 55 Final Report
J A Black AEDC 29 Aug 1978 29 p refs
(AD-A062377 AEDC-TSR-78-P29) Avail NTIS HC A03/MF A01 CSCL 22/2

A 0 03-scale model of the NASA Space Shuttle Orbiter utilizing a flexible and a rigid vertical tail was tested in the Propulsion Wind Tunnel Transonic (16T) at free-stream Mach numbers from 0 90 to 1 55 free stream dynamic pressures from 300 to 700 psf angles of attack from -2 to 12 deg and angles of sideslip from -5 to 9 deg for speedbrake deflections of 25 and 55 deg and rudder deflections of 0 and 10 deg The objective of the test was to determine the effects of vertical tail flexibility on the static stability and control characteristics of the Orbiter vehicle GRA

N79 20180*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
AN OXIDE DISPERSION STRENGTHENED ALLOY FOR GAS TURBINE BLADES
T K Glasgow 1979 13 p refs Presented at the 20th Structures Structural Dyn and Mater Conf St Louis 4 6 Apr 1979 sponsored by AIME and the Am Soc of Civil Engr
(NASA-TM-79088 E-9912) Avail NTIS HC A02/MF A01 CSCL 21H

The strength of the newly developed alloy MA 6000E is derived from a nickel alloy base an elongated grain structure naturally occurring precipitates of gamma prime and an artificial distribution of extremely fine stable oxide particles Its composition is Ni-15Cr-2Mo-2Ta 4W-4 5Al-2 5Ti 0 15Zr 0 05C-0 01B-1 1Y2O3 It exhibits the strength of a conventional nickel base alloy at 1400 F but is quite superior at 2000 F Its shear strength is relatively low necessitating consideration of special joining procedures Its high cycle low cycle and thermal fatigue properties are excellent The relationship between alloy microstructure and properties is discussed Author

N79-20187*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
TUNGSTEN FIBER REINFORCED FeCrAlY A FIRST GENERATION COMPOSITE TURBINE BLADE MATERIAL
D W Petrasek E A Winsa L J Westfall and R A Signorelli 1979 27 p refs Presented at the 108th Ann meeting of the Am Inst of Mining Met and Petroleum Engr New Orleans 18-22 Feb 1979
(NASA-TM-79094 E-9918) Avail NTIS HC A03/MF A01 CSCL 11D

Tungsten-fiber/FeCrAlY (W/FeCrAlY) was identified as a promising aircraft engine first generation turbine blade composite material Based on available data W/FeCrAlY should have the stress-rupture creep tensile fatigue and impact strengths required for turbine blades operating from 1250 to 1370 K It should also have adequate oxidation hot corrosion and thermal cycling damage resistance as well as high thermal conductivity Concepts for potentially low cost blade fabrication were developed These concepts were used to design a first stage JT9D convection cooled turbine blade having a calculated 50 K use-temperature advantage over the directionally solidified superalloy blade LS

N79-20189*# Douglas Aircraft Co Inc Long Beach Calif
A STUDY ON THE UTILIZATION OF ADVANCED COMPOSITES IN COMMERCIAL AIRCRAFT WING STRUCTURE EXECUTIVE SUMMARY
D J Watts Jul 1978 58 p refs
(Contract NAS1-15004)
(NASA-CR-158902-1) Avail NTIS HC A04/MF A01 CSCL 11D

The overall wing study objectives are to study and plan the effort by commercial transport aircraft manufacturers to accomplish the transition from current conventional materials and practices to extensive use of advanced composites in wings of aircraft that will enter service in the 1985-1990 time period Specific wing study objectives are to define the technology and data needed to support an aircraft manufacturer s commitment to utilize composites primary wing structure in future production aircraft and to develop plans for a composite wing technology program which will provide the needed technology and data G Y

N79-20190*# Douglas Aircraft Co Inc Long Beach Calif
A STUDY ON THE UTILIZATION OF ADVANCED COMPOSITES IN COMMERCIAL AIRCRAFT WING STRUCTURE Final Report
D J Watts Jul 1978 249 p refs
(Contract NAS1-15004)
(NASA-CR-158902-2) Avail NTIS HC A11/MF A01 CSCL 11D

A study was conducted to define the technology and data needed to support the introduction of advanced composite materials in the wing structure of future production aircraft The study accomplished the following (1) definition of acceptance factors (2) identification of technology issues (3) evaluation of six candidate wing structures (4) evaluation of five program options (5) definition of a composite wing technology development plan (6) identification of full-scale tests (7) estimation of program costs for the total development plan (8) forecast of future utilization of composites in commercial transport aircraft and (9) identification of critical technologies for timely program planning L S

N79-20222*# General Electric Co Schenectady N Y
EVALUATION OF AN ADVANCED DIRECTIONALLY SOLIDIFIED GAMMA/GAMMA-ALPHA Mo EUTECTIC ALLOY
M F Henry M R Jackson M F X Gigliotti and P B Nelson Jan 1979 67 p refs
(Contract NAS3-20383)
(NASA-CR-159416 SRD-78-191) Avail NTIS HC A04/MF A01 CSCL 11F

An attempt was made to improve on the properties of the candidate jet engine turbine blade material AG 60 a gamma/gamma prime alpha Mo eutectic composite Alloy 38 (AG-170) was evaluated in the greatest detail This alloy Ni 5 88 Al-2 9 74 Mo-1 65 V-1 2C Re (weight percent) represents an improvement beyond AG-60 based on mechanical testing of the transverse and/or longitudinal orientations over a range of temperatures in tension shear rupture and rupture after thermal exposure It is likely that other alloys in the study represent a similar improvement G Y

N79-20228# Air Force Materials Lab Wright-Patterson AFB Ohio
AEROSPACE STRUCTURAL METALS HANDBOOK VOLUME 5 SUPPLEMENT 11 NONFERROUS ALLOYS Quarterly Report, Dec 1978
S S Manson Dec 1978 74 p Suppl to AFML-TR-68-115 Volume 1-4
(AD-A062553 AFML-TR-68-115-Vol-5-Suppl-11) Avail NTIS HC A04/MF A01 CSCL 11/6

This nickel-base alloy containing large additions of aluminum and titanium achieves very high strength at elevated temperature It has thus received considerable attention for application in components of high performance jet engines such as turbine blades vanes and nozzles and even integral turbine wheels Because of the large quantities of strengthening elements included in the composition the alloy is not hot worked and is therefore used in the as-cast condition Recently however there has been considerable development of a powder metallurgy product which permits working of the alloy At high temperatures the powder-consolidated product becomes superplastic thus opening many possibilities in fabrication-to-shape of wrought complex components GRA

N79-20264*# National Aeronautics and Space Administration Washington D C
SOME ASPECTS OF AIRCRAFT JET ENGINE FUELS
R Bekiesinski Apr 1979 11 p refs Transl into ENGLISH from Tech Lotnicza i Astronautyczna (Warsaw) v 33 Sep 1978 p 11-12 Original language document was announced as A79-11368 Transl by Kanner (Leo) Associates Redwood City Calif
(Contract NASw 3199)
(NASA-TM-75395) Avail NTIS HC A02/MF A01 CSCL 21D

Technologies are reviewed for improving the thermal stability of jet fuels with reference to the overheating of fuel tanks in supersonic aircraft Consideration is given to the development of a jet fuel with high thermal stability by the Polish petroleum industry G Y

N79 20265*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
AIRFOIL COOLING HOLE PLUGGING BY COMBUSTION GAS IMPURITIES OF THE TYPE FOUND IN COAL DERIVED FUELS
Daniel L Deadmore and Carl E Lowell Feb 1979 14 p refs
(Contract EF-77-A 01-2593)
(NASA-TM-79076 E-9893 DOE/NASA/2593-79/1) Avail NTIS HC A02/MF A01 CSCL 21D

The plugging of airfoil cooling holes by typical coal derived fuel impurities was evaluated using doped combustion gases in an atmospheric pressure burner rig Very high specific cooling air mass flow rates reduced or eliminated plugging The amount of flow needed was a function of the composition of the deposit It appears that plugging of film cooled holes may be a problem for gas turbines burning coal derived fuels Author

N79-20303# Naval Ocean Systems Center San Diego Calif
AIRBORNE FIBER OPTICS MANUFACTURING TECHNOLOGY AIRCRAFT INSTALLATION PROCESSES Technical Report May - Sep 1978
G Kosmos and R A Greenwell 24 Oct 1978 123 p
(AD A062683 NOSC/TR-340) Avail NTIS HC A06/MF A01 CSCL 17/2

Manufacturing processes are being developed for installation of optical fiber harnesses and stand alone links on military aircraft Fabrication and installation plans and procedures are being developed and a routing analysis is being performed to provide a basis for installation of fiber optics in military aircraft A life cycle cost analysis of the optical fiber harness indicates apparent economic advantages Author (GRA)

N79-20310# Arinc Research Corp Annapolis Md
AN/APS-96 RADAR MODIFICATION PROGRAM Progress Report 1 Nov 1977 - 31 Oct. 1978
W Schulz Nov 1978 27 p
(Contract N00019-77-C 0516)
(AD-A062569 Rept-1711-01-1-1830) Avail NTIS HC A03/MF A01 CSCL 17/9

The Naval Avionics Center (NAC) at Indianapolis Indiana is producing the kit hardware for reliability maintainability and operational improvement modifications of the AN/APS-96 radars in service in E-2B aircraft The series of modification kits designed by ARINC Research Corporation is being installed at NAS Miramar This report covering the period 1 November 1977 through 31 October 1978 summarizes the activities of ARINC Research engineers in supporting the refinement of the designs for kit production at NAC the test and installation of kits at NAS Miramar and the familiarization of the Navy technicians with the modified system Author (GRA)

N79-20311# Boeing Co Seattle Wash
ELECTROMAGNETIC COUPLING ANALYSIS OF A LEARJET AIRCRAFT Final Report, 15 Jun 1977 - 15 Jun 1978
D F Strawe M Obyrne and S Sandberg Sep 1978 84 p refs
(Contract F33615-77-C-2058)
(AD-A062490 D180-24256-1 AFFDL-TR-78-121) Avail NTIS HC A05/MF A01 CSCL 20/14

This report presents the results of an electromagnetic modeling analysis of a Learjet aircraft Coupling models were developed for the aircraft exterior and selected internal cabling Calculations of pulse induced responses were made using the computer codes WIRANT and TRAFFIC The calculated responses were compared to test data obtained by AFFDL Lightning-induced responses were also calculated for a nearby 20 kiloampere stroke Author (GRA)

N79-20319# Boeing Aerospace Co Seattle Wash Engineering Technology Div
HYBRID TECHNOLOGY COST REDUCTION AND RELIABILITY IMPROVEMENT STUDY Final Report
H M Waldron III and L F Buldhaupt Mar 1978 154 p refs
(Contract N00163-77-C 0298)
(AD-A062247 D180-24054-1) Avail NTIS HC A08/MF A01 CSCL 14/1

The objective of this multi-phase program is to develop the materials processes and controls to improve reliability and reduce cost of hybrid microelectronics for application in military avionic systems The objective of the first phase the study effort covered by this report is to develop a data base for the subsequent phases The first phase performed over a 6-month period consisted of two tasks (1) collection of data and information and (2) data assessment and analysis GRA

N79-20326# General Electric Co Cincinnati Ohio Aircraft Engine Group
HYBRID PACKAGING OF INTEGRATED CIRCUITS FOR ENGINE CONTROLS Final Report Aug 1974 - Jan 1978
Howard B Kast and James A Loughran Jul 1978 176 p refs
(Contract F33615-74-C-2070)
(AD-A062125 R78AEG453 AFAPL-TR-78-39) Avail NTIS HC A09/MF A01 CSCL 09/5

This report documents the design test and development of an advanced electronic packaging candidate for future on engine electronic controls Materials with low and well-matched expansion properties special processes and special joining alloys were used because of the large number of thermal cycles expected Tape automated bonding was used because it offers improved reliability and lower production cost Included in the program were temperature cycling thermal shock vibration bench testing and on-engine environmental testing The results obtained were favorable Author (GRA)

N79-20342*# Michigan State Univ East Lansing Dept of Mechanical Engineering
MEASUREMENTS IN A LARGE ANGLE OBLIQUE JET IMPINGEMENT FLOW
John F Foss 7 Aug 1978 48 p Submitted for publication
(Grant NGR-23-004-091)
(NASA-CR-158385) Avail NTIS HC A03/MF A01 CSCL 20D

The flow field associated with the oblique impingement of an axisymmetric jet was investigated in the externally blown flap configuration for the STOL aircraft The passive and active spreading characteristics of the shallow angle (a greater than or ≈ approximately to 15 degrees) oblique impingement flow the role of the initially azimuthal vorticity field and the stagnation point region were studied and compared to the large (a = 45 degrees) oblique jet impingement flow A description of the characteristics of the large angle impingement flow is presented A flow field near the plate as showing two distinct patterns one near the location of the maximum surface pressure and another about the geometric intersection of the jet axis with the plate and turbulence in the region above the plate which is greater than the one accounted for by the convection of turbulence energy by the mean motion M M M

N79-20344*# National Aeronautics and Space Administration Langley Research Center Hampton Va
PRESSURE AND THERMAL DISTRIBUTIONS ON WINGS AND ADJACENT SURFACES INDUCED BY ELEVON DEFLECTIONS AT MACH 6

Louis G Kaufman II (Grumman Aerospace Corp Bethpage N Y) and Charles B Johnson Mar 1979 59 p refs
(NASA-TP-1356 L-12636) Avail NTIS HC A04/MF A01 CSCL 01A

Surface pressure distributions and heat transfer distributions were obtained on wing half models in regions where three dimensional separated flow effects are prominent Unswept and 50 deg and 70 deg swept semispan wings were tested for trailing-edge elevon ramp angles of 0 deg 10 deg 20 deg and 30 deg with and without cylindrical and flat plate center bodies and with and without various wing tip plates and fins The data obtained for a free stream Mach number of 6 and a wing-root-chord Reynolds number of 18 5 million reveal considerably larger regions of increased pressure and thermal loads than would be anticipated using non separated flow analyses Author

N79-20348# Honeywell Inc Minneapolis Minn Avionics Div
ADVANCED FLUIDIC TEMPERATURE STUDIES Final Report 1 Aug 1977 - 31 Mar 1978
Walter M Posingies Oct 1978 80 p refs
(Contract DAAJ02 77-C 0036 DA Proj 1L2-63211 D-157)
(AD A063147 Honeywell-WO454FR1 USARTL-TR-78-33)
Avail NTIS HC A05/MF A01 CSCL 13/7

A Hydrofluidic Stability Augmentation System (HYSAS) developed in a previous program was modified to extend its operating temperature range Baseline performance data parametric test data and a detailed analysis of the selected compensation approaches are presented The compensated system was tested with MIL-H 5606 oil and its gain remained within a + or - 20 percent band over the temperature range from 50 to 180 F Author (GRA)

N79-20349# Air Force Inst of Tech Wright-Patterson AFB Ohio
UNSTEADY BOUNDARY LAYER FLOW REVERSAL IN A LONGITUDINALLY OSCILLATING FLOW Ph D Thesis - Colorado Univ
John Powers Retelle Jr 1978 151 p refs
(AD-A063140 AFIT-CI-79-46D) Avail NTIS HC A08/MF A01 CSCL 20/4

Measurements of boundary layer flow reversal made in a wind tunnel on a stationary NACA 0012 airfoil immersed in a longitudinally oscillating subsonic flow are described A split-film sensor provided flow reversal data in regions above the airfoil surface throughout the period of flow oscillation At angles of attack below the steady-flow stall angle of attack and for small amplitude oscillations regions of boundary layer flow reversal near the leading edge were observed to vary nominally in phase with the time varying external velocity However an increase in the oscillation amplitude produced a phase lead and an increased down-stream extent of the flow reversal region Variations in the oscillation frequency produced only small changes in the shape of the flow reversal region For angles of attack greater than the steady flow stall angle the growth and decay of reversed flow regions were observed to be stronger functions of the velocity oscillation frequency and amplitude Increases in oscillation amplitude produced larger reversal regions which nominally lagged the phase of the free stream velocity It is shown that boundary layer flow reversal on a stationary airfoil in an oscillating free stream responds to changes in the flow unsteadiness in a manner similar to the flow reversal observed during the onset of dynamic stall on an airfoil oscillating in pitch GRA

N79-20354# Naval Postgraduate School Monterey Calif
HOT FLOW TESTING OF MULTIPLE NOZZLE EXHAUST EDUCTOR SYSTEMS M S Thesis
Daniel R Welch Sep 1978 131 p refs
(AD-A062205) Avail NTIS HC A07/MF A01 CSCL 20/4

Hot flow model tests of multiple nozzle exhaust eductor systems were conducted to evaluate effects of exhaust temperature on eductor performance A one dimensional analysis of a simple eductor system based on conservation of momentum for an incompressible gas was used in determining the non dimensional parameters governing the flow phenomenon Eductor performance is defined in terms of these parameters An experimental correlation of these parameters which was previously developed and used to correlate cold flow data was found to be effective in correlating both cold and hot flow data for eductor systems Temperature data was obtained for the mixing stack wall and the exhaust flow at the mixing stack exit plane Author (GRA)

N79-20358# Rockwell International Corp Columbus Ohio Aircraft Div
LIGHTWEIGHT HYDRAULIC SYSTEM EXTENDED ENDURANCE TEST Final Report 24 Dec 1977 - 21 Sep 1978
Joseph N Demarchi and Robert K Haning Sep 1978 43 p refs
(Contract N62269-78-C 0005)
(AD-A062749 NR78H-92 NADC-77218-30) Avail NTIS HC A03/MF A01 CSCL 13/7

A 100 hour endurance test completed in a prior project was extended to 200 hours The evaluation was conducted at 8000 psi and -200 F on hydraulic components in a laboratory system designed to be representative of aircraft-type circuitry The hardware cycled were pump relief valve restrictors solenoid valves flow control valve seals (22) hydraulic fluid (MIL-H-83282) tubing fittings and hoses The test was completed satisfactorily GRA

N79-20374# Washington Univ Seattle
FLUID MECHANICAL REFRACTING GAS PRISM AND AERODYNAMICS OF E - BEAM SUSTAINED DISCHARGE IN SUPERSONIC FLOW BOTH APPLICABLE TO LASER TECHNOLOGY Interim Scientific Report, 1 Jan - 31 Dec 1977
D W Bogdanoff and W H Christiansen May 1978 101 p refs
(Grant AF-AFOSR-2650-74)
(AD A062390 AFOSR-78-1494TR) Avail NTIS HC A06/MF A01 CSCL 20/5

Details are presented of extensive experimental tests of a 90 degree Venus Machine a fluid mechanical optical control device which deflects a beam of light continuously through large angles A motion picture photographic technique was used to obtain extensive data under a variety of operating conditions on the size and shape of the light well a region in the flow where light rays are trapped in near circular paths The angular divergence of the laser beam leaving the Venus Machine was also measured for the same range of operating conditions These experimental results along with parallel theoretical work have allowed a reasonably complete understanding of the operation of the present 90 degree device at low laser power levels and have indicated that potential exists for the design of Venus Machines of much higher performance and optical quality Construction of a ruby laser and the necessary optical and detector systems for high-power Venus Machine transmission was completed Preliminary calibration measurements with the detector system were made Other experimental work is underway to find ways of improving the performance of electron beam sustained electric discharge lasers Some considerations include discharge boundary layer interactions and medium homogeneity Preliminary results of the fundamental mechanisms of the interaction of electrical discharges of the glow type and the fluid mechanics as found in supersonic electric discharge lasers are briefly presented in this report Author (GRA)

N79-20390*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
INVESTIGATION OF WING SHIELDING EFFECTS ON CTOL ENGINE NOISE
Harry E Bloomer 1979 34 p refs Presented at the 5th Annual Aeroacoustics Conf Seattle 12-14 Mar 1979 sponsored by AIAA
(NASA-TM-79078 E-9895) Avail NTIS HC A03/MF A01 CSCL 20K

A full scale engine wing shielding investigation was conducted at the Lewis Research Center using a 97 900-N (22 000 lb) thrust turbofan engine and a simulated wing section sized around

a conventional-take off type four-engine narrow body airplane Sound data were obtained for the wing placed at seven positions in a plane parallel to the engine axis and were compared to data obtained without the wing at both take off and approach power In addition the engine was operated with and without extensive acoustic treatment including a sonic inlet in order to evaluate wing shielding effectiveness with a highly suppressed engine The wing shielding effectiveness was also calibrated using a 3 8 cm diam air nozzle as a second source Results indicated that even though about 10 dB broad band shielding was achieved the equivalent flyover noise reduction was less than 3 0 EPNdB for most configurations Author

N79-20397*# McDonnell-Douglas Corp St Louis Mo
HIGH HEAT FLUX ACTIVELY COOLED HONEYCOMB SANDWICH STRUCTURAL PANEL FOR A HYPERSONIC AIRCRAFT Final Report
L C Koch and L L Pagel Dec 1978 172 p refs
(Contract NAS1-12919)
(NASA CR-2959) Avail NTIS HC A08/MF A01 CSCL 20K

The results of a program to design and fabricate an unshielded actively cooled structural panel for a hypersonic aircraft are presented The design is an all aluminum honeycomb sandwich with embedded cooling passages soldered to the inside of the outer moldline skin The overall finding is that an actively cooled structure appears feasible for application on a hypersonic aircraft but the fabrication process is complex and some material and manufacturing technology developments are required Results from the program are summarized and supporting details are presented G Y

N79-20398*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
ANALYSIS OF HIGH VELOCITY IMPACT ON HYBRID COMPOSITE FAN BLADES
C C Chamis and J H Sinclair 1979 17 p refs Presented at the 20th Structures Structural Dyn and Mater Conf St Louis Mo 4 6 Apr 1979 cosponsored by AIAA ASME ASCE and AHS
(NASA-TM-79133 E-9979) Avail NTIS HC A02/MF A01 CSCL 21E

Recent developments in the analysis of high velocity impact of composite blades are described using a computerized capability which consists of coupling a composites mechanics code with the direct-time integration features of NASTRAN The application of the capability to determine the linear dynamic response of an interply hybrid composite aircraft engine fan blade is described in detail The results also show that the impact stresses reach sufficiently high magnitudes to cause failures in the impact region at early times of the impact event G Y

N79-20400# Aeronautical Research Labs Melbourne (Australia)
STEADY STATE BEHAVIOUR OF A CABLE USED FOR SUSPENDING A SONAR BODY FROM A HELICOPTER
N E Gilbert May 1978 41 p refs
(ARL/AERO-Rept-149 AR-001-269) Avail NTIS HC A03/MF A01

A three-dimensional steady state mathematical model of a cable used to suspend a sonar body from a helicopter is derived Results are presented in dimensionless form for a length of cable totally immersed in any Newtonian fluid and may therefore be applied to a number of practical problems Various approximations are made in order to obtain analytical solutions Author

N79-20409# Advisory Group for Aerospace Research and Development Paris (France)
FRACTURE MECHANICS DESIGN METHODOLOGY
Jan 1979 236 p refs AGARD lecture series presented at Delft The Netherlands 5 6 Oct 1978 Munchen Germany 9-10 Oct 1978 Sacavem Portugal 12-13 Oct 1978
(AGARD-LS-97 ISBN-92-835-1294 4) Copyright Avail NTIS HC A11/MF A01

The state of the art of the application of fracture mechanics to the fail safety and damage tolerance assessment of aircraft structures is examined Basic principles of fracture mechanics are reviewed It is shown that although damage assessment analysis has passed the stage where tests were the only means to get answers to pertinent questions regarding crack growth and residual strength tests are still indispensable

N79-20410# Battelle Columbus Labs Ohio
INTRODUCTION TO FRACTURE MECHANICS
David Broek *In* AGARD Fracture Mech Design Methodology Jan 1979 1 p refs

Avail NTIS HC A11/MF A01

The development of the fracture mechanics discipline for computing and predicting the behavior of flaws and cracks during damage tolerance analysis is summarized Topics discussed include stress intensity factor the parameter for crack growth and fracture plane stress and plane strain toughness and residual strength subcritical crack growth and the energy release rate A R H

N79-20411# Battelle Columbus Labs Ohio
FRACTURE
David Broek *In* AGARD Fracture Mech Design Methodology Jan 1979 15 p refs

Avail NTIS HC A11/MF A01

Because the larger part of the primary structure of large civil aircraft consists of reinforced thin plate plane stress fracture is of vital importance for all major aircraft components The behavior of thin plates and the analysis of plane stress fracture are discussed Plane stress behavior is more difficult to analyze than plane strain behavior and has received relatively little attention in the literature Fracture under plane stress conditions is more complex than plane strain fracture and no rigorous analysis procedures exist However for most practical purposes useful engineering methods can provide approximative answers to plane stress fracture problems Plane stress and transitional fracture are examined A R H

N79-20412# Industrieanlagen-Betriebsgesellschaft m b H Ottobrunn (West Germany)
FATIGUE CRACK GROWTH
Walter Schutz *In* AGARD Fracture Mech Design Methodology Jan 1979 13 p
Avail NTIS HC A11/MF A01

It is now an established fact that structures may go into service containing crack-like manufacturing defects However only in very rare cases these cracks are so large that immediate static failure occurs when the first high service loads occur rather it is the service loads themselves which produce crack growth starting either from the small manufacturing cracks or from notches which are unavoidable in a structure In the first case the whole life of the structure consists of crack growth it ends when the remaining cross section can no longer sustain the service loads and fails statically In the second case at the notch root a crack must first be initiated which then grows to failure and the life consists of the crack initiation and the crack propagation phase In both cases crack propagation and its calculation is therefore an important task at least as important as the calculation of residual static strength and much more difficult This is so because fatigue crack propagation is a cyclic phenomenon and is therefore much more complex and difficult than a static phenomenon One reason is the very large number of parameters therefore experimental verification of calculation methods hypotheses etc is very time-consuming and expensive Author

N79-20413# Northrop Corp Hawthorne Calif Aircraft Group
STRESS INTENSITY ANALYSIS ANALYTICAL, FINITE ELEMENT FOR SURFACE FLAWS HOLES
D P Wilhem *In* AGARD Fracture Mech Design Methodology Jan 1979 19 p refs

Avail NTIS HC A11/MF A01

Several methods are available to obtain stress intensity for developing cracks in structure where uniform loading and

symmetric cracks prevail Unfortunately in all aircraft structure both loading (stress) and crack geometries are far from ideal These factors combined with localized plasticity require the use of more sophisticated means of obtaining stress intensity factors Finite element analysis both with and without special cracked elements can be used to obtain stress intensity values Careful attention must be paid in modeling to account for various factors i e fasteners etc which affect the stress field In many cases where elastic-plastic behavior is evident those finite element programs with nonlinear capability can be effectively used to compute J-integral values for use in both fatigue and fracture studies One case study presented involves a cutout in the wing in a highly stressed region the root Other cases deal with part-through cracks at holes and countersinks and other design details The use of three dimensional finite element models to obtain stress intensities for cracks at holes provides an opportunity to evaluate the merits of each method of analysis analytical finite element and semi empirical Comparisons are presented for several cases A R H

N79-20414# Douglas Aircraft Co Inc Long Beach Calif
DAMAGE TOLERANCE ANALYSIS OF REDUNDANT STRUCTURES
T Swift *In* AGARD Fracture Mech Design Methodology Jan 1979 34 p refs
Avail NTIS HC A11/MF A01

A modern transport aircraft contains wide expanses of basic redundant structure which must be designed with some damage tolerance capability Reliable and economical analytical procedures are therefore required to ensure the most efficient design which will meet these damage tolerance requirements Several kinds of analytical approaches are described including finite element energy release rate and displacement compatibility methods Each of these methods can be used to calculate the crack tip stress intensity and stiffener stress concentration factors necessary for the damage tolerance design of stiffened structure The role that stiffeners play in reducing the crack tip stress intensity factor to a level which can arrest cracks after rapid propagation is described The effects of variations in geometry on the crack tip stress intensity factor stiffener stress and residual strength are presented including the results of a parametric study Finally analytical procedures are described which account for fastener nonlinear shear displacement and the effects of stiffener plasticity Author

N79-20415# Battelle Columbus Labs Ohio
FATIGUE CRACK GROWTH ANALYSIS
David Broek *In* AGARD Fracture Mech Design Methodology Jan 1979 19 p refs

Avail NTIS HC A11/MF A01

Basically damage tolerance means that (real or assumed) cracks do not grow within a certain defined period to a size that would cause loss of the aircraft at a specified load Damage tolerance assessment involves analysis of fatigue and environmentally assisted growth of an initial flaw under the anticipated service loading and the residual strength characteristics of the cracked structure In principle present day fracture mechanics and modern stress analysis techniques permit the prediction of residual strength characteristics of many structures Techniques for dealing with random or quasi-random service-load histories were recently proposed The adequacy of these new techniques for crack growth predictions is examined Because the load spectrum and the stress history are the most important ingredients of a crack growth analysis the development of an adequate stress history is discussed A R H

N79-20416# Industrieanlagen-Betriebsgesellschaft m b H Ottobrunn (West Germany)
DESIGN OF HEAVY SECTIONS
Walter Schutz *In* AGARD Fracture Mech Design Methodology Jan 1979 11 p refs

Avail NTIS HC A11/MF A01

Because most highly loaded heavy section airframe components are manufactured either from plate or from forging their crack propagation and residual static strength properties are of interest to the designer the certification authorities and the operator If heavy section components are made from plate their final shape is obtained by machining interrupting the grain flow For many forgings the original shape is hardly changed by machining However there may be differences in grain flow between individual forgings The available fracture mechanics data of plate or forged aircraft materials are reviewed finally some qualitative suggestions and quantitative results are given for use by the designer of heavy sections A R H

N79-20418# Douglas Aircraft Co Inc Long Beach Calif
DESIGN OF REDUNDANT STRUCTURES
T Swift *In* AGARD Fracture Mech Design Methodology Jan 1979 23 p refs
Avail NTIS HC A11/MF A01

The selection of damage sizes to be used in the design of a large commercial transport aircraft is discussed Development tests are described which assess the capability of different materials and structural configurations to meet the selected criteria Correlation of various analytical methods is shown for varying degrees of damage for both fuselage and wing structural arrangements A limited number of tests are described which verify the chosen inspection intervals for externally detectable damage after internal member failure A R H

N79-20419# Northrop Corp Hawthorne Calif Aircraft Group
ANALYSIS OF AIRCRAFT STRUCTURE USING APPLIED FRACTURE MECHANICS
D P Wilhem *In* AGARD Fracture Mech Design Methodology Jan 1979 17 p refs

Avail NTIS HC A11/MF A01

An aircraft designed and analyzed for a particular set of usages is often placed in a service environment which is more severe than originally planned The consequence of this occurrence is that many design details such as cutouts holes etc are placed in a spectrum of loads which result in higher operating stresses In the original full scale fatigue test a different (design usage) spectrum is usually employed and can only indicate fatigue critical areas Using the finite element approach with stress intensity values and usage spectra estimates are made of the crack growth life for a part through crack at a cutout These data are then used to establish inspection intervals Three distinct spectra were developed to represent usage and analytical/experimental correlation was made for those spectra In the majority of cases good agreement was obtained For these cases where the correlation is not good refinements need to be made to the stress intensity solutions and/or the crack growth model The reliance on more than one method of analysis is recommended for stress intensity evaluation of fatigue and fracture critical areas A comparison of the methods used in determining crack growth parameters sometimes indicates that the added cost of a more complex technique is not warranted particularly when parametric design studies are involved The use of a newer approach to the prediction of both fatigue crack growth and residual strength employing a wide range resistance curve is promising Its usefulness in pinpointing differences in the cutout problem is given A R H

N79-20420# Battelle Columbus Labs Ohio
DAMAGE TOLERANCE IN PRACTICE
David Broek *In* AGARD Fracture Mech Design Methodology Jan 1979 13 P refs

Avail NTIS HC A11/MF A01

Some practical aspects in the application of damage tolerance criteria in the design and operation of aircraft are discussed including the complete fracture control plan Rules issued by various authorities specifying the required damage tolerance of the airplane structure are reviewed The problem of the application of safety factors is particularly from the point of view of crack-growth prediction Because substantial testing is still necessary (and also required by the authorities) damage tolerance testing is examined which offers a possibility for a continuous updating of the predictions of life expectancy and facilitates

management decisions Fleet monitoring is a logical extension of the fracture control plan A R H

N79-20528*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EFFECTS OF AIR INJECTION ON A TURBOCHARGED TELEDYNE CONTINENTIAL MOTORS TSIO-360-C ENGINE
Donald V Cosgrove and Erwin E Kempke 1979 37 p refs Presented at the Business Aircraft Meeting Wichita Kans 3 6 Apr 1979 sponsored by the Soc of Automotive Engr
(NASA-TM-79121 E 9955) Avail NTIS HC A03/MF A01

A turbocharged fuel injected aircraft engine was operated over a range of test conditions that included that EPA five-mode emissions cycle and fuel air ratio variations for individual modes while injecting air into the exhaust gas Air injection resulted in a decrease of hydrocarbons and carbon monoxide while exceeding the maximum recommended turbine inlet temperature of 1650 F at the full rich mixture of the engine Leanout tests indicated that the EPA standards could be met through the combined use of fuel management and air injection Author

N79 20616*# National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt Md
WIND ESTIMATES FROM CLOUD MOTIONS RESULT OF AN IN SITU AIRCRAFT VERIFICATION EXPERIMENT
A F Hasler and W E Shenk *In its* 3d NASA Weather and Climate Program Sci Rev 1977 p 235-239 refs

Avail NTIS HC A14/MF A01 CSCL 04B

A world wide system of 5 geostationary satellites is being established with a primary objective the estimation of winds from cloud motions A series of aircraft experiments were carried out to perform an in situ verification of the satellite cloud winds under undisturbed to moderately disturbed oceanic weather regimes G Y

N79-20621*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
COMMERCIAL AIRCRAFT DERIVED HIGH RESOLUTION WIND AND TEMPERATURE DATA FROM THE TROPICS FOR FGGE IMPLICATIONS FOR NASA
R Steinberg *In* NASA Goddard Space Flight Center 3d NASA Weather and Climate Program Sci Rev 1977 p 265-270

Avail NTIS HC A14/MF A01 CSCL 04B

Two programs involving over 100 commercial aircraft were initiated to provide global high resolution in-situ windfield and temperature data during the FGGE The concepts developed for these programs could have important implications for both meteorology and aviation in the near term G Y

N79-20761# Computer Aided Design Centre Cambridge (England)
GRAPHICAL NC SYSTEMS AS A BASIS FOR PROGRESS TOWARDS THE INTEGRATION OF DESIGN, PLANNING AND MACHINING
B Gott *In* AGARD Computer Aid in the Production Design Office Jan 1979 8 p

Avail NTIS HC A04/MF A01

The systems described are concerned with piece parts on production and design for production Numerical control of programming machining and graphical methods in the computer aided and manufacture throughout all sectors of industry S E S

N79-20762# Societe Nationale Industrielle Aerospatiale Marignane (France)
A COMPUTER AIDED DESIGN AND FABRICATION SYSTEM ADAPTED TO THE DESIGN OF THREE DIMENSIONAL OBJECTS [UN SYSTEME DE CONCEPTION ET FABRICATION ASSISTEES PAR ORDINATEUR ADAPTE A LA CONCEPTION DES OBJECTS TRIDIMENSIONNELS]
Monique Slissa *In* AGARD Computer Aid in the Production Design Office Jan 1979 5 p In FRENCH

Avail NTIS HC A04/MF A01

Computer aided design and fabrication relies on all the capabilities of a data processor to create a product at the least cost as rapidly as possible and to provide for modifications in the shortest period of time For its application the Helicopter Division of Aerospatiale chose the design of three dimensional objects A FORTRAN program developed in the Scientific Information Service and used in industry since 1974 permits the creations and modification of simple and complex forms with the assistance of interactive graphic and alphanumeric screens Development proceeds by taking into consideration the experience acquired by users Favorable comparisons have been made with traditional methods In order to rationalize the management of the created objects an introduction to a new type of data base management system is under study
Transl by A R H

N79-20763# Avions Marcel Dassault-Breguet Aviation Saint-Cloud (France)
DRAPO A COMPUTER AIDED DESIGN AND FABRICATION SYSTEM [DRAPO UN SYSTEME DE CONCEPTION ET DE FABRICATION ASSISTEES PAR ORDINATEUR]
Francis Bernard *In* AGARD Computer Aid in the Production Design Office Jan 1979 12 p

Avail NTIS HC A04/MF A01

The search for maximum optimization in the construction of aircraft of greater and greater complexity led to the use of a totally integrated system of computerized design and fabrication Known as DRAPO the system can be defined partly by the material adopted whose choice determines the mode of utilization and partly by its principal functions form definition curves surfaces and volume The motivations and research objects prompting the use of the system are summarized Its principal aspects are described and its use is demonstrated in several examples Transl by A R H

N79-20765# Messerschmitt-Boelkow-Blohm G m b H Munich (West Germany)
CAD FOR ELECTRIC SYSTEMS DESIGN
Guenter Broll *In* AGARD Computer Aid in the Production Design Office Jan 1979 8 p

Avail NTIS HC A04/MF A01

The large amount of paper work prepared by aircraft production for high performance aircraft design is presented CAD is designed to meet the needs with respect to speed reliability and costs savings The electric design data is defined by standards supplier lists and specifications The data is converted into drawings and information for production to reach scheduled run times S E S

N79-20766# Aeritalia S p A Torino (Italy)
AERITALIA POINT OF VIEW AND OBJECTIVES ON COMPUTER AIDED DESIGN
M Castagneri *In* AGARD Computer Aid in the Production Design Office Jan 1979 7 p

Avail NTIS HC A04/MF A01

A analysis of the usage of computer aids in the design and manufacturing areas is presented A guideline to improve and collect all the computer programs includes the following features (1) to build up a system administrating a unique data base (2) to optimize flow times manpower requirements and (3) to increase cost benefits S E S

N79-20767# British Aerospace Aircraft Group Weybridge (England)
A DISCUSSION OF THE PRODUCTION DESIGN OFFICE BENEFITS OF C A D
L H Dyson *In* AGARD Computer Aid in the Production Design Office Jan 1979 4 p

Avail NTIS HC A04/MF A01

Mathematical models representing the different trends in the aircraft industry are presented The different design phases design processes improvements production engineering cost reductions data bases are reported S E S

N79-20769*# Analytic Sciences Corp Reading Mass
USERS MANUAL FOR LINEAR TIME-VARYING HELICOPTER SIMULATION (PROGRAM TVHIS)
Michael R Burns Mar 1979 86 p refs
(Contract NAS1-14358)
(NASA-CR-159020) Avail NTIS HC A05/MF A01 CSCL 09B

A linear time-varying helicopter simulation program (TVHIS) is described The program is designed as a realistic yet efficient helicopter simulation It is based on a linear time-varying helicopter model which includes rotor actuator and sensor models as well as a simulation of flight computer logic The TVHIS can generate a mean trajectory simulation along a nominal trajectory or propagate covariance of helicopter states including rigid body turbulence control command controller states and rigid body state estimates J M S

N79-20787*# Vought Corp Hampton Va Technical Center
VORTAB - A DATA-TABLET METHOD OF DEVELOPING INPUT DATA FOR THE VORLAX PROGRAM
Frederick M Denn Mar 1979 82 p refs
(Contract NAS1-13500)
(NASA-CR-159026) Avail NTIS HC A05/MF A01 CSCL 09B

A method of developing an input data file for use in the aerodynamic analysis of a complete airplane with the VORLAX computer program is described The hardware consists of an interactive graphics terminal equipped with a graphics tablet Software includes graphics routines from the Tektronix PLOT 10 package as well as the VORTAB program described The user determines the size and location of each of the major panels for the aircraft before using the program Data is entered both from the terminal keyboard and the graphics tablet The size of the resulting data file is dependent on the complexity of the model and can vary from ten to several hundred card images After the data are entered two programs READB and PLOTB are executed which plot the configuration allowing visual inspection of the model L P

N79-20827* National Aeronautics and Space Administration Pasadena Office Calif
ACOUSTIC DRIVING OF ROTOR Patent
Hilda Kanber (JPL) Isadore Rudnick (JPL) and Taylor G Wang inventors (to NASA) (JPL) Issued 13 Feb 1979 4 p Filed 5 Jul 1977 Supersedes N78 22859 (16 - 13 p 1773) Sponsored by NASA
(NASA-Case-NPO 14005-1 US Patent-4 139 806
US Patent-Appl-SN-812447 US-Patent-Class-318-116
US Patent-Class 60-721 US Patent-Class-73-505
US Patent-Class 310 322 US-Patent Class-310 334
US Patent-Class 310-20 US Patent Class-310 26) Avail US Patent and Trademark Office CSCL 20A

Sound waves are utilized to apply torque to a body in an enclosure of square cross section by driving two transducers located on perpendicular walls of an enclosure at the same frequency but at a predetermined phase difference such as 90 degrees The torque is a first order effect so that large and controlled rotational speeds can be obtained
Official Gazette of the U S Patent and Trademark Office

N79 20830*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
EFFECTS OF GEOMETRIC AND FLOW-FIELD VARIABLES ON INVERTED-VELOCITY-PROFILE COAXIAL JET NOISE
James R Stone 1979 30 p refs Presented at the 5th Aeroacoustics Conf Seattle 12-14 Mar 1979 sponsored by AIAA
(NASA-TM-79095 E-9919) Avail NTIS HC A03/MF A01 CSCL 20A

Relationships between the noise generation characteristics and the flow field characteristics for inverted-velocity profile coaxial jets are discussed Noise measurements were made at four different sideline distances in order to determine the apparent noise source locations and flow field characteristics were determined from jet plume pressure/temperature surveys These relationships are based on a published NASA Lewis prediction model the basic assumptions of which are shown to be consistent with the experimental data reported herein Improvements to the noise prediction procedure on the basis of the present study are included which increase the accuracy of the high frequency noise prediction A R H

N79-20831*# Georgia Inst of Tech Atlanta
APPLICATION OF FINITE ELEMENT TECHNIQUES IN PREDICTING THE ACOUSTIC PROPERTIES OF TURBOFAN INLETS Interim Technical Report
R K Majjigi R K Sigman and B T Zinn [1978] 194 p refs
(Grant NsG 3036)
Avail NTIS HC A09/MF A01 CSCL 20A

An analytical technique was developed for predicting the acoustic performance of turbofan inlets carrying a subsonic axisymmetric steady flow The finite element method combined with the method of weighted residuals is used in predicting the acoustic properties of variable area annular ducts with or without acoustic treatments along their walls An approximate solution for the steady inviscid flow field is obtained using an integral method for calculating the incompressible potential flow field in the inlet with a correction to account for compressibility effects The accuracy of the finite element technique was assessed by comparison with available analytical solutions for the problems of plane and spinning wave propagation through a hard walled annular cylinder with a constant mean flow A R H

N79-20832*# National Aeronautics and Space Administration Langley Research Center Hampton Va
EFFECTS OF DURATION AND OTHER NOISE CHARACTERISTICS ON THE ANNOYANCE CAUSED BY AIRCRAFT-FLYOVER NOISE
David A McCurdy and Clemans A Powell Mar 1979 47 p refs
(NASA-TP-1386 L-12579) Avail NTIS HC A03/MF A01 CSCL 20A

A laboratory experiment was conducted to determine the effects of duration and other noise characteristics on the annoyance caused by aircraft-flyover noise Duration doppler shift and spectra were individually controlled by specifying aircraft operational factors such as velocity altitude and spectrum in a computer synthesis of the aircraft-noise stimuli This control allowed the separation of the effects of duration from the other main factors in the experimental design velocity tonal content and sound pressure level The annoyance of a set of noise stimuli which were comprised of factorial combinations of a 3 durations 3 velocities 3 sound pressure levels and 2 tone conditions were judged The judgements were made by using a graphical scale procedure similar to numerical category scaling Each of the main factors except velocity was found to affect the judged annoyance significantly The interaction of tonal content with sound pressure level was also found to be significant The duration correction used in the effective perceived-noise-level procedure 3 dB per doubling of effective duration was found to account most accurately for the effect of duration No significant effect doppler shift was found L P

N79-20834# Air Force Flight Dynamics Lab Wright Patterson AFB Ohio
AIRFRAME AERODYNAMIC NOISE-TOTAL RADIATED ACOUSTIC POWER APPROACH Final Report Jan 1976 - Jan 1978
Leonard L Shaw Nov 1978 80 p refs
(AF Proj 2401)
(AD-A062861 AFFDL-TR-78-141) Avail NTIS HC A05/MF A01 CSCL 01/1

During flight the noise radiated by aircraft is emanating from two distinct types of sources One source is the propulsion system and the other is the non propulsion system noise or airframe noise associated with movement of the aircraft through the atmosphere The purpose of this effort was to study the air frame noise using a total radiated acoustic power approach Methodology was developed to accurately calculate the total acoustic power by using measurements from an array of microphones during aircraft flyover This methodology was applied to Schweizer 2-32 glider flyovers and it was found that for an aerodynamic

configuration(no flaps wheels wheel wells etc) the total acoustic power can be obtained from one flyover measurement by assuming the directivity is nearly equal in all directions This assumption was shown to be valid for the glider and is assumed valid for any aircraft in an aerodynamic configuration The detailed methodology developed is still useful since most commercial aircraft land in a non-aerodynamic configuration and thus their directivity is not equal in all directions The results from the glider tests were compared to data in the literature and found to agree well Variation of the total power with aircraft velocity followed a V to the sixth power law The parameter which normalizes the overall acoustic power from different aircraft was found to be the wing area Author (GRA)

N79-20977# European Space Agency Paris (France)
VISCOUS-INVISCID FLOW MATCHING NUMERICAL METHOD AND APPLICATIONS TO TWO-DIMENSIONAL, TRANSONIC AND SUPERSONIC FLOWS
Jean-Claude LeBalleur *In its* La Rech Aerospatiale Bi-monthly Bull No 1978-2 (ESA-TT-496) Nov 1978 p 26-48 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1978-2 Mar-Apr 1978 p 65 76 Original report in FRENCH previously announced as A78-38698

Avail NTIS HC A05/MF A01

An automatic iterative method is proposed for solving two dimensional problems of strong interaction between a perfect fluid and boundary layers It can be integrated into numerical methods for solving perfect fluid flows by relaxation The usual direct iteration is stabilized by means of a local underrelaxation coefficient A new semi-inverse iteration permits extending a direct perfect-fluid calculation to regions of separation These regions can be multiple and develop on their own In supersonic regime a well-posed problem is solved that involves a downstream boundary condition even when the flow does not obey a simple wave law The method is applied to a supersonic compression ramp and symmetric profiles in transonic flow
Author (ESA)

N79-20980# European Space Agency Paris (France)
LA RECHERCHE AEROSPATIALE BI-MONTHLY BULLETIN NO 1978-3
Dec 1979 107 p refs Transl into ENGLISH of La Rech Aerospatiale Bull Bimestriel (Paris) no 1978-3 May-Jun 1978 p 99-142 Original French report available from ONERA Paris FF 36
(ESA-TT-522) Avail NTIS HC A06/MF A01

The following topics are discussed turbulence statistics in gas with varying entropy the optical predictions of a high velocity premixed turbulent flame flutter suppressors for transonic flight linearized theory of the plane unsteady supersonic flow through a cascade (subsonic leading edge locus) calculation of exchange coefficients for high temperature turbine blades and in flight utilization of an optical fiber transmission system on a Falcon 10 aircraft

N79-20983# European Space Agency Paris (France)
FLUTTER SUPPRESSOR FOR TRANSONIC FLIGHT
Roger Destuynder *In its* La Rech Aerospatiale Bi monthly Bull No 1978-3 (ESA-TT-522 Dec 1979 p 46 64 refs Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1978-3 May-Jun 1978 p 117-123 Original report in FRENCH previously announced as A78 47346

Avail NTIS HC A06/MF A01

A dynamically similar model of the half-wing of a modern aircraft was equipped with a weighted external tank in order to obtain flutter at transonic velocity Flutter control is achieved by a classical aileron that produces a reduction in frequency of the lowest flutter mode through the effect of negative stiffness Significant gain in the critical dynamic pressure and Mach number were achieved Different values of the feedback phase were employed in order to determine the stability range as a function of feedback phase Author (ESA)

N79-20986# European Space Agency Paris (France)
INFLIGHT UTILIZATION OF AN OPTICAL FIBER TRANSMISSION SYSTEM ON A FALCON 10 AIRCRAFT
Joseph Taillet and Jean Reibaud *In its* La Rech Aerospatiale Bi-monthly Bull No 1978-3 (ESA-TT-522) Dec 1979 p 98-103 Transl into ENGLISH from La Rech Aerospatiale Bull Bimestriel (Paris) no 1978-3 May-Jun 1978 p 139-141 Original report in FRENCH previously announced as A78-47349

Avail NTIS HC A06/MF A01

A device for measuring the current from a potential discharger uses optical fiber for digital transmission The operation of the device mounted on an aircraft was tested in flight The first tests show that the signal to-noise ratio is greatly improved over that of the conventional transmission system Author (ESA)

N79-20989*# National Aeronautics and Space Administration Hugh L Dryden Flight Research Center Edwards Calif
CORRELATION OF PREDICTED AND MEASURED THERMAL STRESSES ON AN ADVANCED AIRCRAFT STRUCTURE WITH SIMILAR MATERIALS
Jerald M Jenkins Apr 1979 40 p refs
(NASA-TM-72862 H 1086) Avail NTIS HC A03/MF A01 CSCL 02A

A laboratory heating test simulating hypersonic heating was conducted on a heat-sink type structure to provide basic thermal stress measurements Six NASTRAN models utilizing various combinations of bar shear panel membrane and plate elements were used to develop calculated thermal stresses Thermal stresses were also calculated using a beam model For a given temperature distribution there was very little variation in NASTRAN calculated thermal stresses when element types were interchanged for a given grid system Thermal stresses calculated for the beam model compared similarly to the values obtained for the NASTRAN models Calculated thermal stresses compared generally well to laboratory measured thermal stresses A discrepancy of significance occurred between the measured and predicted thermal stresses in the skin areas A minor anomaly in the laboratory skin heating uniformity resulted in inadequate temperature input data for the structural models A R H

N79-20990# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
TRANSONIC AERODYNAMIC TESTING
Jan 1972 383 p refs Lecture held at Rhode Saint Genese Belgium 17-21 Jan 1972
(VKI-Lecture Series 42) Avail NTIS HC A17/MF A01

The following topics are discussed (1) aircraft in transonic flight (2) scale effect at transonic speeds (3) transonic wind tunnels (4) design and characteristics of high Reynolds number test facilities (Ludwieg Tube) (5) boundary layer effects on pressure variations in Ludwieg Tubes (6) the design of wind tunnel models for tests at transonic speeds and high Reynolds numbers (7) flight test techniques for a transonic aircraft (8) experimental techniques for transonic testing in shock tubes and (9) possibilities for scale effect on swept wings at high subsonic speeds

N79-20991# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)
THE PROBLEM AIRCRAFT IN TRANSONIC FLIGHT
B H Goethert *In its* Transonic Aerodyn Testing Jan 1972 40 p refs
Avail NTIS HC A17/MF A01

Graphs representing the various aerodynamic characteristic data obtained through wind tunnel and flight testing of aircraft at transonic speeds are presented G Y

N79 20992# National Aero and Astronautical Research Inst Amsterdam (Netherlands)
SCALE EFFECTS AT TRANSONIC SPEEDS BASIC CONSIDERATIONS

J P Hartzuiker *In* Von Karman Inst for Fluid Dyn Transonic Aerodyn Testing Jan 1972 22 p refs

Avail NTIS HC A17/MF A01

The aerodynamic phenomena on modern aircraft wings at transonic speeds are so complex that understanding them will rely on experiments for a long period to come All problems discussed are mainly illustrated by means of two-dimensional airfoils Except maybe for wings with large regions of separated flow where three dimensional effects are certainly present the analogy between two dimensional flows and the flow over the important parts of swept wings appears to justify this approach The following topics are discussed (1) the flow over transonic airfoils (2) shock wave boundary layer interactions (3) pressure gradient separations and (4) the type of pressure distribution in the supersonic region G Y

N79-20993# ARO Inc Arnold Air Force Station Tenn

TRANSONIC WIND TUNNELS

Michael Pindzola *In* Von Karman Inst for Fluid Dyn Transonic Aerodyn Testing Jan 1972 88 p refs

Avail NTIS HC A17/MF A01

A short review of the evolution of transonic wind tunnels is presented Those problem areas which prevent an exact duplication of free flight conditions in a transonic wind tunnel are analyzed Wall interference in subsonic wind tunnels and wave reflections in supersonic wind tunnels are discussed G Y

N79-20994*# National Aeronautics and Space Administration Marshall Space Flight Center Huntsville Ala

DESIGN AND CHARACTERISTICS OF HIGH REYNOLDS NUMBER TEST FACILITIES THE LUDWIG TUBE

A R Felix *In* Von Karman Inst for Fluid Dyn Transonic Aerodyn Testing Jan 1972 38 p

Avail NTIS HC A17/MF A01 CSCL 14B

Graphs and data tables are presented for the design and characteristics of high Reynolds number test facilities (wind tunnels) G Y

N79 20995# Technische Hochschule Darmstadt (West Germany)

BOUNDARY LAYER EFFECTS ON PRESSURE VARIATIONS IN LUDWIEG TUBES

Eckart Piltz *In* Von Karman Inst for Fluid Dyn Transonic Aerodyn Testing Jan 1972 7 p refs

Avail NTIS HC A17/MF A01

Ludwieg Tubes or Tube Wind Tunnels are rather simple gas dynamic testing facilities in which almost steady sub- and supersonic flow can be maintained for some period of time Basic to the operation cycle of a Ludwieg Tube is an expansion wave which propagates down a cylindrical tube serving as gas storage Soon after Ludwieg s suggestion for construction of such tubes theoretical calculations were made to predict the boundary layer growth and the resulting variations of pressure and stagnation pressure as well as other thermodynamic properties of the tube flow Experimental results are given to test the theory In addition it is shown how the original theory should be modified and/or simplified to give good agreement with experimental data G Y

N79-20996# Royal Aircraft Establishment Bedford (England) Aerodynamics Dept

THE DESIGN OF WIND TUNNEL MODELS FOR TESTS AT TRANSONIC SPEEDS AND HIGH REYNOLDS NUMBERS

C R Taylor *In* Von Karman Inst for Fluid Dyn Transonic Aerodyn Testing Jan 1972 36 p refs

Avail NTIS HC A17/MF A01

Two principle subjects are addressed the limitations imposed by model design on the extent to which high tunnel pressures can be used to obtain higher model Reynolds numbers and the matching of model and aircraft shapes The discussion is confined to models of aircraft with swept wings of moderate to high aspect ratio G Y

N79-20997# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium)

FLIGHT TEST TECHNIQUES FOR A TRANSONIC AIRCRAFT

J M Lewendon *In its* Transonic Aerodyn Testing Jan 1972 32 p

Avail NTIS HC A17/MF A01

By popular definition a transonic aircraft is one which is incapable of supersonic speeds in level flight but has to dive in order to attain speeds in excess of Mach 1 0 The majority of the flight tests made on a transonic aircraft are at subsonic conditions up to perhaps Mach 97 with opportunities to explore in brief periods the aircraft s characteristics when flying at speeds in excess of Mach 1 0 The test techniques described align themselves to this conclusion G Y

N79-20998# Institute of Fluid Mechanics and Aerospatial Design Bucharest (Rumania)

EXPERIMENTAL TECHNIQUES FOR TRANSONIC TESTING IN SHOCK TUBES

Lucian Z Dumitrescu *In* Von Karman Inst for Fluid Dyn Transonic Aerodyn Testing Jan 1972 43 p refs

Avail NTIS HC A17/MF A01

Even in the early stages of its development the shock tube was put to use for the study of transonic aerodynamic phenomena by the pioneers in the field But very soon the advent of large scale test facilities continuous or intermittent relegated the shock-tube to other applications of which the main aerodynamic one is the production of hypersonic high enthalpy flows However the use of shock-tubes for generating transonic flows has some unique advantages which will become apparent hereafter these led to a program aimed at solving a number of problems in connection to this method G Y

N79-20999# Aircraft Research Association Ltd Bedford (England)

POSSIBILITIES FOR SCALE EFFECT ON SWEPT WINGS AT HIGH SUBSONIC SPEEDS RECENT EVIDENCE FROM PRESSURE PLOTTING TESTS

A B Haines *In* Von Karman Inst for Fluid Dyn Transonic Aerodyn Testing Jan 1972 34 p refs Also presented at AGARD Fluid Dyn Panel Specialists Meeting Goettingen West Ger 26-28 Apr 1971

(Rept-18 Paper-14) Avail NTIS HC A17/MF A01

The possibilities for scale effect on swept wings under supercritical flow conditions at high subsonic speeds are discussed on the basis of evidence from pressure plotting tests on a variety of wings For the Super VC 10 comparison of pressure distributions measured in flight and in model tests at R = 5 400 000 shows some scale effect but it is not dramatic largely because there is no incipient rear separation tendency in the tunnel tests For other designs however the scale effect could be much greater the paper shows that the underfixing technique has limitations when applied to a sweptback wing Examples are included where the flow patterns are very complex with many interacting features G Y

N79-21000*# United Technologies Research Center East Hartford Conn

STUDY OF FUTURE WORLD MARKETS FOR AGRICULTURAL AIRCRAFT Progress Report May 1978 - Feb 1979

F W Gobetz and R J Assarabowski Apr 1979 214 p refs (Contract NAS1-14795)

(NASA CR-158937 R79-912839 24) Avail NTIS HC A10/MF A01 CSCL 02A

The future world market for US manufactured agricultural aircraft was studied and the technology needs for foreign markets were identified Special emphasis was placed on the developing

country market but the developed countries and the communist group were also included in the forecasts Aircraft needs were projected to the year 2000 by a method which accounted for field size crop production treated area productivity and attrition of the fleet A special scenario involving a significant shift toward aerial fertilization was also considered An operations analysis was conducted to compare the relative application costs of various existing and hypothetical future aircraft A case study was made of Colombia as an example of a developing country in which aviation is emerging as an important industry J M S

N79-21001*# Aerophysics Research Corp Bellevue Wash
NSEG A SEGMENTED MISSION ANALYSIS PROGRAM FOR LOW AND HIGH SPEED AIRCRAFT VOLUME 3 DEMONSTRATION PROBLEMS Final Report
D S Hague and H L Rozendaal Washington NASA Sep 1977 181 p 3 Vol
(Contract NAS1-13599)
(NASA CR-2809) Avail NTIS HC A09/MF A01 CSCL 02A

Program NSEG is a rapid mission analysis code based on the use of approximate flight path equations of motion Equation form varies with the segment type for example accelerations climbs cruises descents and decelerations Realistic and detailed vehicle characteristics are specified in tabular form In addition to its mission performance calculation capabilities the code also contains extensive flight envelope performance mapping capabilities For example rate of climb turn rates and energy maneuverability parameter values may be mapped in the Mach altitude plane Approximate take off and landing analyses are also performed At high speeds centrifugal lift effects are accounted for Extensive turbojet and ramjet engine scaling procedures are incorporated in the code Author

N79-21002 Engineering Sciences Data Unit London (England)
INTRODUCTION TO EQUATIONS OF MOTION FOR PERFORMANCE
1978 15 p
(ESDU-78038 ISBN-0-85679-242-X) For information on availability of series subseries or individual data items write NTIS Attn ESDU Springfield Va 22161 HC E99

This item presents the equations of motion of rigid bodies and a number of associated relationships which may be used in both the prediction of and analysis of measurements of aircraft point performance The equations are presented in general form with the nature of the forces and moments unspecified and the user should consult the appropriate Data items in the Sub series for advice regarding the significant forces and moments to be considered in the solution of particular problems The opportunity has been taken in this item to link the Performance Sub series with the Terms and symbols for flight dynamics adopted by the International Organization for Standardization since this provides a comprehensive notation together with definitions and sign conventions for most axis systems forces moments angles etc which are likely to be used in performance work ESDU

N79 21003 Pennsylvania State Univ University Park.
SECONDARY-FLOW-RELATED VORTEX CAVITATION Ph D Thesis
Michael Leroy Billet 1978 200 p
Avail Univ Microfilms Order No 7909045

A study is presented of a vortex formed near the inner wall of a rotor operating within a boundary layer Experimental critical cavitation data and laser Doppler anemometer measurements obtained downstream of the rotor plane are given for many flow configurations In addition rotor inlet and outlet velocity profiles were measured Experimental results show an influence of inlet velocity gradient near the inner wall on the critical cavitation number of the vortex Secondary flow vorticity equations are developed and employed to calculate the vorticity in the blade passage near the inner wall of a rotor The secondary vorticity induces an additional component of tangential velocity which was found to increase the flow turning near the inner wall This increased tangential velocity profile compared favorably with the measured vortex profile outside of the vortex core region Dissert Abstr

N79-21005*# Ecodynamics Research Associates Inc Albuquerque N Mex
SEMIDIRECT COMPUTATION OF THREE-DIMENSIONAL VISCOUS FLOWS OVER SUCTION HOLES IN LAMINAR FLOW CONTROL SURFACES Final Report
Patrick J Roache Mar 1979 23 p refs
(Contract NAS1-15045)
(NASA-CR-159017) Avail NTIS HC A02/MF A01 CSCL 01A

A summary is given of the attempts made to apply semidirect methods to the calculation of three dimensional viscous flows over suction holes in laminar flow control surfaces The attempts were all unsuccessful due to either (1) lack of resolution capability (2) lack of computer efficiency or (3) instability Author

N79-21009*# Applied Physics Lab Johns Hopkins Univ Laurel Md
BUMBLEBEE PROGRAM AERODYNAMIC DATA PART 1 SUPERSONIC FLOW FIELD PRESSURE FIELD AND PANEL LOAD DATA FOR VALIDATION OF COMPUTATIONAL METHODS Final Report
G A Barnes and L L Cronvich Mar 1979 12 p refs
(NASA Order L-60036 A)
(NASA-CR-3114) Avail NTIS HC A02/MF A01 CSCL 01A

The parts of an aerodynamics research project of the Bumblebee Program called Generalized Missile study is described The source related and potential applications are discussed S E S

N79-21010*# Beam Engineering Inc Sunnyvale Calif
STRUCTURE OF THE TURBULENT SEPARATED FLOW AROUND A STALLED AIRFOIL Interim Report
Alan J Wadcock Feb 1979 88 p refs
(Contract NAS2-10093)
(NASA-CR 152263) Avail NTIS HC A05/MF A01 CSCL 01A

Hot-wire measurements were made in the boundary layer the separated region and the near wake for flow past a NACA 4412 airfoil at maximum lift The Reynolds number based on chord was 1 500 000 Special care was taken to achieve a two-dimensional mean flow Data were obtained at several thousand locations in the flow field These data include intermittency two components of mean velocity and mean values for three double four triple and five quadruple products of two velocity fluctuations No information was obtained about the third (spanwise) velocity component Smoothing and interpolating routines were used to determine intermittency two components of mean velocity and mean values of three double four triple and five quadruple products of two velocity fluctuations on a fine rectangular mesh aligned with the airfoil chord The data are presented in contour plots in three dimensional plots and in tabular form The format used to store the experimental data in digital form is described and a computer program which illustrates how this data can be accessed is presented L S

N79-21011*# West Virginia Univ Morgantown Dept of Aerospace Engineering
GENERALIZATION OF ANALYTICAL TOOLS FOR HELICOPTER-ROTOR AIRFOILS Final Report
Edward H Gibbs 18 Apr 1979 14 p refs
(Grant NsG-1412)
(NASA-CR-158480) Avail NTIS HC A02/MF A01 CSCL 01A

A state-of-the art finite difference boundary layer program incorporated into the NYU Transonic Analysis Program is described Some possible treatments for the trailing edge region were investigated Findings indicate the trailing edge region still within the scope of an iterative potential flow boundary layer program appears feasible S E S

N79 21012# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 4B ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SPLIT-FILM DATA BASIC CONFIGURATION WAKE EXPLORATIONS Final Report 15 Mar 1977 - 13 Feb 1978

Philip F Sheridan Sep 1978 331 p
(Contract DAAJ02-77-C 0020 DA Proj 1L2-62209-AH 76)
(AD-A063712 USARTL-TR-78-23D-Vol-4B) Avail NTIS HC A15/MF A01 CSCL 01/3

This is the second of the seven sub volumes of Volume IV containing one third octave band spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub volume deals with wake characteristics of the baseline configurations Author (GRA)

N79-21013# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 4A ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SPLIT-FILM DATA BUILDUP TO BASELINE Final Report 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 214 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH 76)
(AD-A063711 USARTL-TR-78-23D-Vol 4A) Avail NTIS HC A10/MF A01 CSCL 01/3

This is the first of the seven sub volumes of Volume IV containing one-third octave band spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub-volume deals with the wake changes as the model is built up to the baseline configuration Author (GRA)

N79-21014# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 4-D ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SPLIT-FILM DATA OPEN HUBCAPS Final Report, 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 401 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209-AH-76)
(AD A063214 USARTL-TR-78-23D-Vol-4D) Avail NTIS HC A18/MF A01 CSCL 01/3

This is the fourth of the seven sub volumes of Volume IV containing one third octave band spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub-volume deals with the effects of various open hubcaps Open caps have parallel undersides and uppersides Author (GRA)

N79-21015# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 7-B FREQUENCY ANALYSES OF WAKE SPLIT-FILM DATA, BASIC CONFIGURATION WAKE EXPLORATIONS Final Report Mar 1977 - Feb 1978
Philip F Sheridan Sep 1978 334 p
(Contract DAAJ02-77-C 0020 DA Proj 1L2 62209 AH-76)
(AD-A063243 USARTL-TR-78-23G-Vol 7B) Avail NTIS HC A15/MF A01 CSCL 01/3

This is the second of seven sub volumes of Volume VII containing spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub volume deals with wake characteristics of the baseline configurations Author (GRA)

N79-21016# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 4F ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SPLIT-FILM DATA AIR EJECTORS WITH HUBCAPS, WINGS Final Report 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 232 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2-62209 AH-76)
(AD-A063244, USARTL-TR-78-23D-Vol-4F) Avail NTIS HC A11/MF A01 CSCL 01/3

This is the sixth of the seven sub volumes of Volume IV containing one third octave band spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub volume deals with the effects of air ejector systems in configurations already possessing hub caps and also of several wing configurations mounted variously to alter the wake Author (GRA)

N79-21017# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 5 HARMONIC ANALYSES OF HUB WAKE Final Report Mar 1977 - Feb 1978
Philip F Sheridan Sep 1978 239 p
(Contract DAAJ02-77 C-0020 DA Proj 1L2-62209-AH-76)
(AD-78 A063245 USARTL-TR-23E-Vol-5) Avail NTIS HC A11/MF A01 CSCL 01/3

Volume V of this series contains computer print-outs displaying the results of harmonic analyses of selected test runs The steady and 10-harmonic coefficients for wake flow angles and associated velocity components are shown This material is compiled to enable understanding of the wake structure additional to that derived from the spectrographs in other volumes Author (GRA)

N79-21018# Boeing Vertol Co Philadelphia Pa
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION VOLUME 4E ONE-THIRD OCTAVE BAND SPECTROGRAMS OF WAKE SPLIT-FILM DATA, AIR EJECTORS Final Report 15 Mar 1977 - 13 Feb 1978
Philip F Sheridan Sep 1978 342 p
(Contract DAAJ02-77-C-0020 DA Proj 1L2 62209 AH-76)
(AD-A063653 USARTL-TR-78-23D-Vol-4E) Avail NTIS HC A15/MF A01 CSCL 01/3

This is the fifth of the seven sub-volumes of Volume IV containing one-third octave band spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices This sub volume deals with the effects of various air ejector systems on the wake Author (GRA)

N79-21021*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
OZONE CONTAMINATION IN AIRCRAFT CABINS
Washington D C NASA Mar 1979 81 p refs Workshop held at Moffett Field Calif 27-28 Jul 1978
(NASA-CP-2066 E-9797) Avail NTIS HC A05/MF A01 CSCL 06S

The problem and solution to the physical ozone irritation caused by ozone concentrations in the cabin of high-altitude aircraft are presented

N79-21022*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
OZONE CONTAMINATION IN AIRCRAFT CABINS OBJECTIVES AND APPROACH
Porter J Perkins *In its* Ozone Contamination in Aircraft Cabins Mar 1979 p 1-2
Avail NTIS HC A05/MF A01 CSCL 06S

Three panels were developed to solve the problem of ozone contamination in aircraft cabins The problem is defined from direct in flight measurements of ozone concentrations inside and outside airliners in their normal operations Solutions to the cabin ozone problem are discussed under two areas (1) flight planning to avoid high ozone concentrations and (2) ozone destruction techniques installed in the cabin air systems S E S

N79-21023*# Federal Aviation Administration Washington D C
RECOMMENDATIONS OF THE PANELS PANEL ON IN-FLIGHT MEASUREMENTS
Jim Rogers *In* NASA Lewis Res Center Ozone Contamination in Aircraft Cabins Mar 1979 p 3 6

Avail NTIS HC A05/MF A01 CSCL 06S

The attenuation factor for aircraft other than the B-747 in reducing the ambient ozone concentrations which enter the cabin is obtained The need to continue NASA Global Air Sampling Program measurements was expressed for three main purposes testing new filters correlation of complaints with ozone levels and ambient ozone data The need to continue cooperation

between NASA and industry is indicated Concern with regard to the correlation of ozone levels and complaints was given The need to measure the variability of ozone within the aircraft cabin was investigated The requirement for an onboard ozone monitor on all aircraft is discussed S E S

N79-21024*# State Univ of New York at Albany
RECOMMENDATIONS OF THE PANELS PANEL ON FLIGHT PLANNING TO AVOID HIGH OZONE
Volker Mohnen *In* NASA Lewis Res Center Ozone Contamination in Aircraft Cabins Mar 1979 p 7-8

Avail NTIS HC A05/MF A01 CSCL 06S

Flights planned or accomplished during certain months of the year at the higher latitudes and altitudes at or above the tropopause are discussed Cabin ozone level limitations are established and additional information is required for more accurate and qualtitative forecasting and design data base for operational utilization Better tropopause heights ozone concentration and corresponding meteorological data along selected flight routes and meteorological data were investigated S E S

N79-21026*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
OZONE CONTAMINATION IN AIRCRAFT CABINS SUMMARY OF RECOMMENDATIONS
Porter J Perkins *In its* Ozone Contamination in Aircraft Cabins Mar 1979 p 11-12

Avail NTIS HC A05/MF A01 CSCL 06S

Recommendations from the three panels on in-flight measurements flight planning to avoid high ozone and ozone destruction techniques are summarized S E S

N79-21027*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
OZONE CONTAMINATION IN AIRCRAFT CABINS POST WORKSHOP REVIEW OF RECOMMENDATIONS
Porter J Perkins *In its* Ozone Contamination in Aircraft Cabins Mar 1979 p 13-16

Avail NTIS HC A05/MF A01 CSCL 06S

The recommendations level of priority for accomplishment and recommended approaches and responsibility for implementation as established by the review are presented S E S

N79 21028*# Civil Aeromedical Inst Oklahoma City Okla
OZONE CONTAMINATION IN AIRCRAFT CABINS APPENDIX A OZONE TOXICITY
Carlton E Melton *In* NASA Lewis Res Center Ozone Contamination in Aircraft Cabins Mar 1979 p 17-20

Avail NTIS HC A05/MF A01 CSCL 06S

The recommendation that at various altitudes the amount of air with which ozone has mixed changes thus changing the volume per volume relationship is discussed The biological effects of ozone on human health and the amount of ozone necessary to produce symptoms were investigated S E S

N79-21029*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
OZONE CONTAMINATION IN AIRCRAFT CABINS APPENDIX B OVERVIEW PAPERS IN-FLIGHT MEASUREMENTS
Porter J Perkins *In its* Ozone Contamination in Aircraft Cabins Mar 1979 p 21-29

Avail NTIS HC A05/MF A01 CSCL 06S

The NASA Global Atmospheric Sampling Program ozone measurements were obtained to establish to characteristics of the ambient ozone concentration during routine operations and to determine the attenuation of ambient concentrations of cabin air systems from simultaneous ambient and in cabin measurements The characteristics of ambient ozone include (1) maximum concentration (2) duration of ozone encounters (3) frequency of ozone during a flight (4) variability of ozone during a flight (5) in relation to routes altitude and meteorological conditions S E S

N79-21030*# Control Data Corp Minneapolis Minn Research Div
OZONE CONTAMINATION IN AIRCRAFT CABINS APPENDIX B OVERVIEW PAPERS FLIGHT S PLANNING TO AVOID HIGH OZONE
Arthur D Belmont *In* NASA Lewis Res Center Ozone Contamination in Aircraft Cabins Mar 1979 p 31-44 refs

Avail NTIS HC A05/MF A01 CSCL 06S

The problem of preventing cabin ozone from exceeding a given standard was investigated Statistical analysis of vertical distribution of ozone is summarized The cost logistics maintenance ability to forecast ozone and avoiding high ozone concentrations are presented Filtering approaches and the requirements to remove ozone toxicity are discussed S E S

N79 21031*# Boeing Commercial Airplane Co Seattle Wash
OZONE CONTAMINATION IN AIRCRAFT CABINS APPENDIX B OVERVIEW PAPERS OZONE DESTRUCTION TECHNIQUES
Ray Wilder *In* NASA Lewis Res Center Ozone Contamination in Aircraft Cabins Mar 1979 p 45-70

Avail NTIS HC A05/MF A01 CSCL 06S

Ozone filter test program and ozone instrumentation are presented Tables on the flight tests samll scale lab tests and full scale lab tests were reviewed Design verification flammability vibration accelerated contamination life cycle and cabin air quality are described S E S

N79 21032# Simat Helliesen and Eichner Inc Washington D C
ADDITIONAL ANALYSES OF AIR CARRIED LOAD FACTORS AND COMPETITION Final Report
Apr 1978 106 p refs
(Contract DOT-OS-60501)
(PB-289577/9 DOT-P-50 78-4) Avail NTIS HC A06/MF A01 CSCL 01B

Every competitive domestic market segment served by each airline is analyzed The major results are (1) the impact of CAB imposed operating restrictions result in sharply lower load factors for the restricted carriers than the unrestricted carriers (2) carriers operate a large number of short haul (under 200 miles) entry or bridge segments with low load factors due to the interdependent nature of the markets (3) load factors for unrestricted carriers do not invariably decline as the number of competitors increase and (4) the impact on market load factors of a new unrestricted competitor will necessarily vary depending upon the cost and scheduling characteristics of the added competitor GRA

N79-21033*# Massachusetts Inst of Tech Cambridge Lab for Information and Decision Systems
SIMULATION EVALUATION OF COMBINED 4D RNAV AND AIRBORNE TRAFFIC SITUATION DISPLAYS AND PROCEDURES APPLIED TO TERMINAL AERIAL MANEUVERS Semi-annual Progress Report 1 Sep 1978 - 1 Mar 1979
Michael Athans and Mark E Connelly 1 Mar 1979 44 p
(Grant NsG-2180)
(NASA-CR-158474) Avail NTIS HC A03/MF A01 CSCL 17G

Simulation scenarios were developed in which subject pilots must simultaneously follow a 3D terminal airspace structure and arrive at fixed waypoints within the structure precisely at pre scheduled times in the presence of a full range of wind conditions aloft and monitor nearby traffic on an airborne traffic situation display especially during merging and spacing operations and detect blunders and resolve conflicts in a safe manner Open-loop simulator tests of the single-stage 4D RNAV algorithm indicate that a descending pilot can comply quite closely with an assigned time of arrival at a 3D waypoint simply by tracking a pre-calculated speed profile Initial experiments show

that the aircraft arrives at the 3D waypoint within a few seconds of the anticipated time The presence of headwinds or tailwinds does not affect the arrival time error as long as the wind is accurately modeled in the descent algorithm Results all but quarantee that a 5 second standard deviation in arrival time error can be realized in closed-loop descents at very moderate pilot workload levels A R H

N79-21036# Federal Aviation Administration Washington D C Systems Research and Development Service
MASTER PLAN FLIGHT SERVICE STATION AUTOMATION PROGRAM
Jan 1978 82 p refs
(AD-A052001/5 FAA-FSS 01A) Avail NTIS HC A05/MF A01 CSCL 17/7

The Master Plan for the Flight Service Automation Program is a planning document for the implementation of the Flight Service Information System and serves as the acquisition authorization document This document contains background and introductory information relating to the present system of 292 manned domestic Flight Service Stations program objectives requirements planning guidelines systems and system interface descriptions scheduling and implementation information relationships with other major programs management method logistics staffing training security and financial planning information Author

N79-21037# Draper (Charles Stark) Lab Inc Cambridge Mass
A NEW BASELINE FOR THE INERTIAL NAVIGATION STRAPDOWN SIMULATOR PROGRAM VOLUME 1 INTRODUCTION AND SUMMARY Progress Report 1 Jun 1977 - 15 Jul 1978
Roy J Nurse John T Prohaska and Darold G Riegsecker Jul 1978 15 p ref 4 Vol
(Contract F33615-75 C-1149 AF Proj 6095)
(AD-A062807 R-1136-Vol-1) Avail NTIS HC A02/MF A01 CSCL 17/7

This four-volume report describes an updated and expanded version of a direct digital modular simulation of a strapdown inertial navigation system employing a wander-azimuth computational frame and subject to a six degree of freedom random vibration environment The original version of this simulation was developed under Task 4 2 3(a) of the above contract during 1975 and 1976 The user may simulate not only the gross dynamics of the flight profile (from an external or internal profile generation) but also the angular and linear random vibrations resulting from gusts and turbulence acting on the airframe The total environment is applied to the models of the inertial components (laser or SDR gyros and pendulous accelerometers) The resulting outputs of simulated IMU are summed in an interface module and compensated and scaled in the simulated navigation computer The latter also contains the velocity/attitude algorithm which computes the body-to inertial transformation using either the direction cosine matrix or quaternion and the navigation algorithm which numerically integrates the specific forces after transformation to the local vertical wander azimuth computational frame The outputs of the simulated navigation computer are the computed position velocity and attitude of the vehicle with respect to a local vertical north pointing frame The flight profile and the differences between it and the simulated navigation computer outputs are tabulated in an evaluation module for printing plotting or post processing GRA

N79-21038# Draper (Charles Stark) Lab Inc Cambridge Mass
A NEW BASELINE FOR THE INERTIAL NAVIGATION STRAPDOWN SIMULATOR PROGRAM VOLUME 2 ANALYTICAL DEVELOPMENT Progress Report, 1 Jun 1977 - 15 Jul 1978
Roy J Nurse John T Prohaska and Darold G Riegsecker Jul 1978 208 p refs 4 Vol
(Contract F33615-75-C 1149 AF Proj 6095)
(AD-A062808 R-1136-Vol 2) Avail NTIS HC A10/MF A01 CSCL 17/7

Volume 2 of a four volume report is presented The four volume report describes an update and expanded version of a direct digital modular simulation of a strapdown inertial navigation system employing a wander-azimuth computational frame and subject to a six degree of freedom random vibration environment Volume 2 contains analytical development of the equations to be mechanized and the transition to difference equation form G Y

N79 21039# Draper (Charles Stark) Lab Inc Cambridge Mass
A NEW BASELINE FOR THE INERTIAL NAVIGATION STRAPDOWN SIMULATOR PROGRAM VOLUME 3 PROGRAM AND DESCRIPTION AND USERS GUIDE Progress Report 1 Jun 1977 - 15 Jul 1978
Roy J Nurse John T Prohaska and Darold G Riegsecker Jul 1978 220 p
(Contract F33615-75 C-1149 AF Proj 6095)
(AD-A062809 R-1136-Vol-3) Avail NTIS HC A10/MF A01 CSCL 17/7

This four-volume report describes an updated and expanded version of a direct digital modular simulation of a strapdown inertial navigation system employing a wander-azimuth computational frame and subject to a six degree of freedom random vibration environment The original version of this simulation was developed under Task 4 2 3(a) of the above contract during 1975 and 1976 The user may simulate not only the gross dynamics of the flight profile (from an external or internal profile generation) but also the angular and linear random vibrations resulting from gusts and turbulence acting on the airframe The total environment is applied to the models of the inertial components (laser or SDR gyros and pendulous accelerometers) The resulting outputs of simulated IMU are summed in an interface module and compensated and scaled in the simulated navigation computer The latter also contains the velocity/attitude algorithm which computes the body-to inertial transformation using either the direction cosine matrix or quaternion and the navigation algorithm which numerically integrates the specific forces after transformation to the local vertical wander azimuth computational frame The outputs of the simulated navigation computer are the computed position velocity and attitude of the vehicle with respect to a local vertical north pointing frame The flight profile and the differences between it and the simulated navigation computer outputs are tabulated in an evaluation module for printing plotting or post processing GRA

N79-21040# Draper (Charles Stark) Lab Inc Cambridge Mass
A NEW BASELINE FOR THE INERTIAL NAVIGATION STRAPDOWN SIMULATOR PROGRAM VOLUME 4 PROGRAM LISTINGS Progress Report, 1 Jun 1977 - 15 Jul 1978
Roy J Nurse Jul 1978 106 p 4 Vol
(Contract F33615-75-C-1149 AF Proj 6095)
(AD A062810 R-1136-Vol-4) Avail NTIS HC A06/MF A01 CSCL 17/7

This four-volume report describes an updated and expanded version of a direct digital modular simulation of a strapdown inertial navigation system emping a wander-azimuth computational frame and subject to a six degree of freedom random vibration environment The original version of this simulation was developed under Task 4 2 3(a) of the above contract during 1975 and 1976 The user may simulate not only the gross dynamics of the flight profile(from an external or internal profile generation) but also the angular and linear random vibrations resulting from gusts and turbulence acting on the airframe The total environment is applied to the models of the inertial components (laser or SDR gyros and pendulous accelerometers) The resulting outputs of simulated IMU are summed in an interface module and compensated and scaled in the simulated navigation computer The latter also contains the velocity/attitude algorithm which computes the body to inertial transformation using either the direction cosine matrix or quaternion and the navigation algorithm which numerically integrates the specific forces after transformation to the local vertical wander-azimuth computational frame The outputs of the simulated navigation computer are the computed position velocity and attitude of the vehicle with respect to a local vertical north pointing frame The computer outputs are tabulated in an evaluation module for printing plotting or post processing GRA

N79-21041# Applied Physics Lab Johns Hopkins Univ Laurel Md
THE NEAR-TERM POTENTIAL OF DOPPLER LOCATION
R R Newton Sep 1978 56 p refs
(Contract N00024-78-C-5384)
(AD A063615 APL/JHU-TG-1318) Avail NTIS HC A04/MF A01 CSCL 17/7

In this report the precision that can be obtained in locating a point on the earth s surface by analyzing the Doppler shift in the signals from a near-earth satellite is explored When the discussion to the use of techniques that have been demonstrated in the laboratory but that may not have been introduced into field use is limited it is found that the precision obtained by using the data from a single pass of a satellite should be about 18 cm It should be possible to improve the precision by using data from more than one pass in the usual statistical fashion
Author (GRA)

N79-21043*# Boeing Commercial Airplane Co Seattle Wash
EVALUATION OF LAMINAR FLOW CONTROL SYSTEM CONCEPTS FOR SUBSONIC COMMERCIAL TRANSPORT AIRCRAFT Summary Report, Sep 1976 - Sep 1978
Hampton Va NASA Jan 1979 79 p refs
(Contract NAS1-14630)
(NASA-CR-158998) Avail NTIS HC A05/MF A01 CSCL 01C

Results of a 2-year study are reported which were carried out to extend the development of laminar flow control (LFC) technology and evaluate LFC systems concepts The overall objective of the LFC program is to provide a sound basis for industry decisions on the application of LFC to future commercial transports The study was organized into major tasks to support the stated objectives through application of LFC systems concepts to a baseline LFC transport initially generated for the study Based on competitive evaluation of these concepts a final selection was made for incorporation into the final design of an LFC transport which also included other advanced technology elements appropriate to the 1990 time period G Y

N79-21044*# Boeing Commercial Airplane Co Seattle Wash
DEVELOPMENT OF INTEGRATED PROGRAMS FOR AEROSPACE-VEHICLE DESIGN (IPAD) REFERENCE DESIGN PROCESS Final Report
Donald D Meyer Mar 1979 370 p
(Contract NAS1-14700)
(NASA-CR-2981 D6-IPAD-70010-D) Avail NTIS HC A16/MF A01 CSCL 01C

The airplane design process and its interfaces with manufacturing and customer operations are documented to be used as criteria for the development of integrated programs for the analysis design and testing of aerospace vehicles Topics cover design process management general purpose support requirements design networks and technical program elements Design activity sequences are given for both supersonic and subsonic commercial transports naval hydrofoils and military aircraft A R H

N79-21047# Textron Bell Helicopter Ft Worth Tex
ENGINE/AIRFRAME/DRIVE TRAIN DYNAMIC INTERFACE DOCUMENTATION Final Report Sep 1977 - Aug 1978
H W Hanson R W Balke B D Edwards W W Riley and B D Downs Oct 1978 204 p refs
(Contract DAAJ02-77-C-0045 DA Proj 1L2-62209 AH-76)
(AD-A063237 USARTL-TR-78-15) Avail NTIS HC A10/MF A01 CSCL 01/3

The purpose of this program was to survey Bell Helicopter Textron past and present experiences as related to gas turbine powered helicopter engine/airframe/drive train dynamic interface problems as part of an overall Government effort to define specific areas in which future research funding should be placed to develop improved design analytical and test methods to ensure helicopter dynamic compatibility Thirteen dynamic interface problems were documented with a detailed discussion solutions considered and/or applied and identifiable shortcomings Recommendations are made for future research funding in five specific areas The appendixes provide the detailed documentation for each of the dynamic interface problems Author (GRA)

N79-21048# Air Force Avionics Lab Wright-Patterson AFB Ohio
DIGITAL AVIONICS INFORMATIONS SYSTEM (DAIS) SERIAL INPUT/OUTPUT (I/O) EXERCISE Interim Technical Report Nov 1977 - Jan 1978
James C Caffrey Sep 1978 35 p
(AF Proj 2052)
(AD-A062646 AFAL-TR-78-141) Avail NTIS HC A03/MF A01 CSCL 09/2

The Digital Avionics Information System (DAIS) Test Facility requires a means for exercising the serial output and input interface devices of the remote terminal This report describes the design and operation of the unit needed to perform this function
Author (GRA)

N79-21050# General Dynamics Corp Fort Worth Tex
F-16 ADVANCED ELECTRO-OPTICAL POD FIELD OF-VIEW SIMULATION STUDY Final Report
13 Dec 1978 124 p refs
(Contract F33657-78-C 0290)
(AD-A063530 FZM-6817) Avail NTIS HC A06/MF A01 CSCL 17/8

An F-16 advanced electro-optical(EO) pod field of view(FOV) simulation study was accomplished to determine the effects of sensor FOV and field of-regard (FOR) on the pilot s workload and ability to locate acquire and attack targets in a day weapons-delivery environment The simulated EO pod had a slewable TV sensor and laser designator head with two selectable FOVs for the TV sensor(wide and narrow FOVs) selectable area correlation and contrast tracking modes and the capability to be either slaved to a preprogrammed set of coordinate or slaved to the aircraft s velocity vector Each experiment was designed around a laser-guided weapon and a corresponding weapon delivery mode The weapons simulated in the study were chosen from current and potential (weapons under development) laser guided ordnance -- GBU-10 Laser Guided Maverick and Sabre The weapon delivery modes simulated were derived from basic F-16 avionics capabilities The weapons and weapon delivery modes were chosen to interact with the FOVs of the simulated EO pod so that each FOV pair could be evaluated under separate acquisition range weapons delivery and target constraints GRA

N79-21053# Von Karman Inst for Fluid Dynamics Rhode Saint-Genese (Belgium)
PROCEEDINGS OF THE SEMINAR ON ADVANCED PROBLEMS IN TURBOMACHINERY, PART 1
K Cassady ed and J Chauvin ed Oct 1965 200 p refs Seminar held at Rhode-Saint-Genese Belgium 29-30 Mar 1965 2 Vol
(VKI Lecture-Series-1 Pt-1) Avail NTIS HC A09/MF A01

Topics discussed include methods of prediction of turbomachine performance cascade flows and validity of application to actual cascades advanced transonic and supersonic compressors high turning blading for axial flow machines and turbomachinery space applications

N79-21056# Liverpool Univ (England)
CIRCUMFERENTIAL ASYMMETRY IN AXIAL FLOW COMPRESSORS
M D C Doyle S L Dixon and J H Horlock *In* Von Karman Inst for Fluid Dyn Proc of the Seminar on Adv Probl in Turbomachinery Pt 1 Oct 1965 16 p refs

Avail NTIS HC A09/MF A01

Circumferential inlet distortion and self induced flow asymmetry in axial flow compressors where the distortion of the velocity profile is too large to be described as a small perturbation are discussed Prediction is presented of the compressor characteristics in the inlet distortion stage Prediction of the compressor characteristics in the stalled region is described
S E S

N79-21058# English Electric Co Ltd Whetstone (England) Mechanical Engineering Lab
RESTRICTIVE ASSUMPTIONS AND RANGE OF VALIDITY OF SCHLICHTING'S CASCADE ANALYSIS

R I Lewis P D Cliff and Y M Yip *In* Von Karman Inst for Fluid Dyn Proc of the Seminar on Adv Probl in Turbomachinery Pt 1 Oct 1965 45 p ref

Avail NTIS HC A09/MF A01

Restrictions imposed by the assumptions of Schlichtings cascade theory for slender airfoils were examined Modifications to the source series to remove the the assumption of a cusp trailing edge are suggested and illustrated by comparison with exact theory Two high camber cascade analyses are compared with the exact solution of Merchant and Collar Comparisons are given for isolated profiles obtained by the Joukowski transformation A number of comparisons with experimental hydrofoil cascade tests and with published cascade theories are presented S E S

N79-21059# Rolls-Royce Ltd Derby (England)
TWO-DIMENSIONAL COMPRESSIBLE POTENTIAL FLOW AROUND PROFILES IN CASCADE
D Price *In* Von Karman Inst for Fluid Dyn Proc of the Seminar on Adv Probl in Turbomachinery Pt 1 Oct 1965 19 p ref
Avail NTIS HC A09/MF A01

The extension of the Martensen method to compressible flows is presented The compressible potential equation is approximated by a Poisson equation which is solved by a singularity method S E S

N79 21060# Rolls-Royce Ltd Derby (England)
A STALL CRITERION FOR CASCADES
R M Raley *In* Von Karman Inst for Fluid Dyn Proc of the Seminar on Adv Probl in Turbomachinery Pt 1 Oct 1965 18 p
Avail NTIS HC A09/MF A01

A criterion for stall in axial compressors which is easy to apply is presented The scope of the investigation is discussed and its present position is described A diffusion factor based on the ratio of component of the outlet velocity in the inlet direction to the inlet velocity was studied The critical value of the diffusion factor which depends upon the camber and the ratio of some passage or flow width to the chord length is summarized S E S

N79-21061# Liverpool Univ (England)
PRESSURE DISTRIBUTIONS ON AXIAL FLOW COMPRESSOR BLADING AND COMPARISON WITH DISTRIBUTIONS ON SIMILAR CASCADE BLADING
M D C Doyle and R Shaw *In* Von Karman Inst for Fluid Dyn Proc of the Seminar on Adv Probl in Turbomachinery Pt 1 Oct 1965 15 p refs

Avail NTIS HC A09/MF A01

Pressure distributions on the inlet guide vane rotor and stator blades of a low speed axial flow compressor were obtained at various Reynolds numbers angles of incidence and a axial velocity ratios For one particular incidence these distributions are compared with those obtained from cascade tests of similar blading over approximately the same range of Reynolds numver and axial velocity ratio S E S

N79 21067# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt Porz (West Germany)
THE NASA-LANGLEY 7-INCH TRANSONIC CASCADE WIND TUNNEL AT THE DEUTSCHE VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT AND FIRST TEST RESULTS
W Heilmann *In* Von Karman Inst for Fluid Dyn Proc of the Seminar on Adv Probl in Turbomachinery Pt 2 Oct 1965 25 p refs
Avail NTIS HC A10/MF A01

After discontinuation of the turbomachine research program the Langley Field 7-inch transonic cascade wind tunnel was transferred to the von-Karman institute at Brussels However the available air supply was not sufficient for operating this tunnel The tunnel was installed and equipped with new instrumentation and it was put into operation in 1964 The following topics are reported (1) description of the tunnel (2) instrumentation (3) data reduction (wake and surface pressure distribution measurements) (4) the Schlieren system and (5) control of boundary layer suction The results of the first test are given G Y

N79-21068# Von Karman Inst for Fluid Dynamics Rhode-Saint-Genese (Belgium) Turbomachinery Lab
HIGH TURNING BLADING FOR AXIAL FLOW MACHINES INTRODUCTION AND SUMMARY OF THE PROBLEMS
J Chauvin *In its* Proc of the Seminar on Adv Probl in Turbomachinery Pt 2 Oct 1965 9 p refs

Avail NTIS HC A10/MF A01

The problem of turning flow of a large angle arises frequently in turbomachinery The same problem arises in the subsonic and transonic ranges in the root section of rotors and stators of advanced axial compressors and in the last stage of light weight engines The problem also arises in transonic flow for the stator of certain types of supersonic compressors and in the inducer part of radial compressors The biggest problems encountered in high turning blading arise from the decelerating cascades There appears the problem of limit loading and of boundary layer behavior when speaking of a two dimensional flow There are the additional complications of three dimensional or secondary flow arising from the viscous interaction between wall boundary layers and blade boundary layers These problems are introduced and discussed G Y

N79-21070# International Research and Development Co Ltd Newcastle (England)
EXTENSIONS TO THE TESTED RANGE OF A CASCADE FLOW CALCULATION METHOD
W S Hall *In* Von Karman Inst for Fluid Dyn Proc of the Seminar on Adv Probl in Turbomachinery Pt 2 Oct 1965 10 p refs
Avail NTIS HC A10/MF A01

Some additional results which extend the tested range of mathematical validity of a conformal transformation method for calculating the inviscid incompressible flow about a cascade of aerofoils of general geometry are presented Author

N79 21072# Air Force Systems Command Wright-Patterson AFB Ohio
SUMMARY OF APPLIED RESEARCH PROGRAMS BEING CONDUCTED ON MINIATURE TURBOMACHINES FOR PRODUCING CRYOGENIC TEMPERATURES OPERATING ON GAS BEARINGS TURBO COMPRESSORS AND EXPANDERS UTILIZING HELIUM AND NITROGEN AS WORKING FLUIDS
F R Stidham *In* Von Karman Inst for Fluid Dyn Proc of the Seminar on Adv Probl in Turbomachinery Pt 2 Oct 1965 26 p
Avail NTIS HC A10/MF A01

An attempt is made to briefly summarize the work going on at the author s laboratory and other places The programs are presented in a brief outline form G Y

N79-21073*# Detroit Diesel Allison Indianapolis Ind
STUDY OF AN ADVANCED GENERAL AVIATION TURBINE ENGINE (GATE) Final Report
J C Gill F R Short D V Staton B A Zolezzi C E Curry M J Orelup J M Vaught and J M Humphrey 10 Apr 1979 147 p refs
(Contract NAS3-20756)
(NASA-CR-159558 DDA-EDR-9528) Avail NTIS HC A07/MF A01 CSCL 21E

The best technology program for a small economically viable gas turbine engine applicable to the general aviation helicopter and aircraft market for 1985-1990 was studied Turboshaft and turboprop engines in the 112 to 746 kW (150 to 1000 hp) range and turbofan engines up to 6672 N (1500 lbf) thrust were considered A good market for new turbine engines was predicted for 1988 providing aircraft are designed to capitalize on the advantages of the turbine engine Parametric engine families

were defined in terms of design and off-design performance mass and cost These were evaluated in aircraft design missions selected to represent important market segments for fixed and rotary-wing applications Payoff parameters influenced by engine cycle and configuration changes were aircraft gross mass acquisition cost total cost of ownership and cash flow Significant advantage over a current technology small gas turbine engines was found especially in cost of ownership and fuel economy for airframes incorporating an air-cooled high pressure ratio engine A power class of 373 kW (500 hp) was recommended as the next frontier for technology advance where large improvements in fuel economy and engine mass appear possible through component research and development S E S

N79 21074*# General Electric Co Cincinnati Ohio Aircraft Engine Group
CF6 JET ENGINE PERFORMANCE IMPROVEMENT PROGRAM TASK 1 FEASIBILITY ANALYSIS Final Report
W A Fasching Mar 1979 300 p refs
(Contract NAS3-20629)
(NASA-CR-159450 R79AEG295) Avail NTIS HC A13/MF A01 CSCL 21E

Technical and economic engine improvement concepts selected for subsequent development include (1) fan improvement (2) short core exhaust (3) HP turbine aerodynamic improvement (4) HP turbine roundness control (5) HP turbine active clearance control and (6) cabin air recirculation The fuel savings for the selected engine modification concepts for the CF6 fleet are estimated S E S

N79-21076*# Pratt and Whitney Aircraft Group East Hartford Conn
JT8D REVISED HIGH-PRESSURE TURBINE COOLING AND OTHER OUTER AIR SEAL PROGRAM
W O Gaffin 20 Mar 1979 59 p refs
(Contract NAS3 20630)
(NASA-CR 159551 PWA-5515-77) Avail NTIS HC A04/MF A01 CSCL 21E

The JT8D high pressure turbine was revised to reduce leakage between the blade tip shrouds and the outer air seal and engine testing was performed to determine the effect on performance The addition of a second knife-edge on the blade tip shroud the extension of the honeycomb seal land to cover the added knife-edge and an existing spoiler on the shroud and a material substitution in the seal support ring to improve thermal growth characteristics are included A relocation of the blade cooling air discharge to insure adequate cooling flow is required Significant specific fuel consumption and exhaust gas temperature improvements were demonstrated with the revised turbine in sea level and simulated altitude engine tests Inspection of the revised seal hardware after these tests showed no unusual wear or degradation S E S

N79-21078# Lundgren (Dale A) Gainesville Fla
LOW EFFICIENCY CONTROL MEASURES FOR JET ENGINE TEST CELLS Final Report Apr - Sep 1978
Dale A Lundgren Sep 1978 25 p refs
(Contract F08637-78-M-1387)
(AD-A062665 CEEDO TR-78-53) Avail NTIS HC A02/MF A01 CSCL 21/2

This report summarizes the findings of low cost relatively low efficiency emission control measures for reduction of jet engine test cell opacity to less than 20% The recommended cost effective opacity reduction system consists of an effective water spray system a glass fiber mist eliminator a medium efficiency high velocity throw-away type glass fiber filter media and a reduced test cell discharge area The report discussed the following topics control methods opacity scrubbers demisters and filters Author (GRA)

N79-21079# Naval Research Lab Washington D C
THREE-DIMENSIONAL PHOTOELASTIC STRESS ANALYSIS OF THE DOVETAIL REGION OF THE TF-30 TURBINE ENGINE S THIRD-STAGE FAN Final Report
V J Parks and R J Sanford 29 Dec 1978 32 p refs
(AD A063300 NRL-8276) Avail NTIS HC A03/MF A01 CSCL 21/5

Three dimensional photoelastic analysis of the disk/blade dovetail region of the TF-30 turbine engine s third stage fan indicates peak stresses in the disk and blade fillets that are an order of magnitude greater than the average stress in the neck of the disk lug Maximum stress concentrations found in the fillets of the disk lugs for representative loads are 9 6 for centrifugal load 12 6 for centrifugal load with 12% circumferential component and 10 6 for centrifugal load with an 18% antiplane component The addition of circumferential or antiplane bending components to the centrifugal load increased the peak stress and shifted it toward the region of the fillet where fractures were observed The analysis gives quantitative indication of the significance of bending in the failure of disk lugs Author (GRA)

N79-21080# Naval Postgraduate School Monterey Calif
EXPERIMENTAL INVESTIGATION OF TURBOJET TEST CELL AUGMENTORS Final Report
Charles N Sapp Jr and David W Netzer Sep 1978 71 p refs
(AD-A063172 NPS67-78-009) Avail NTIS HC A04/MF A01 CSCL 21/5

A one eighth scale turbojet test cell was used to investigate the effects of various design parameters on augmentor performance The augmentor inlet design nozzle-to augmentor spacing engine flow rate nozzle total temperature and pressure and augmentor tube diameter were varied to determine what effect they had on augmentation ratio total air pumped through the system and pressure temperature and velocity distributions within the augmentor tube In addition two augmentor tubes were combined in tandem to investigate the characteristics of a tertiary augmentor configuration Author (GRA)

N79-21082# Air Force Inst of Tech Wright-Patterson AFB Ohio
DETERMINATION OF THE STABILITY AND CONTROL DERIVATIVES FOR THE VARIABLE-RESPONSE RESEARCH AIRCRAFT USING A MODIFIED MAXIMUM LIKELIHOOD ESTIMATOR M S Thesis
Jean Michel Fernand Sep 1978 141 p refs
(AD A063270 AFIT-CI-79 43T) Avail NTIS HC A07/MF A01 CSCL 01/3

A maximum likelihood estimation program was applied to flight data for Princeton s Variable Response Research Aircraft to determine its primary stability and control derivatives The control derivatives for the side force surfaces and the rudder were of special interest The effects of measurement noise and process noise on parameter identification also were studied This investigation showed that the maximum likelihood estimation program used identifies derivatives which produce close fits of the measured time histories Standard deviations of the derivations computed from several time histories indicate the quality of the estimates The reduction in standard deviations when estimates were separated by type and direction of control input time history used indicates that derivative estimates are affected by the assumptions inherent in the analytical model and the signal-to noise ratios of the data The method used for identifying highly correlated derivatives also affected the estimates obtained The final set of derivatives determined in this research produced a good fit of the measured data and several of the derivatives agreed well with analog matching derivative estimates Author (GRA)

N79 21083* National Aeronautics and Space Administration Langley Research Center Hampton Va
WIND TUNNEL Patent
Eldon M Wilson inventor (to NASA) (Garrett Corp Los Angeles) Issued 8 Jul 1969 3 p Filed 22 Jun 1967 Sponsored by NASA
(NASA Case LAR-10135-1 US-Patent 3 453 878 US-Patent Appl-SN 648034 US-Patent-Class 73-147) Avail US Patent and Trademark Office CSCL 14B

A supersonic wind wind tunnel is described for testing several air foils mounted in a row A test section of a wind tunnel contains means for mounting air foil sections in a row means for rotating each section about an axis so that the angle of

attack of each section changes with the other sections and means for rotating the row with respect to the air stream so that the row forms an oblique angle with the air stream
Official Gazette of the U S Patent and Trademark Office

N79-21097*# National Aeronautics and Space Administration Langley Research Center Hampton Va
WIND TUNNEL REAL-TIME DATA ACQUISITION SYSTEM
Patricia Cole 1979 23 p refs
(NASA-TM-80081) Avail NTIS HC A02/MF A01 CSCL 14B

The hardware configuration is described for the data acquisition system (DAS) which consists of an analog front end that can process up to 260 channels of data a multichannel analog-to-digital subsystem that can process up to 50 000 samples of data per second and a digital computer with standard and nonstandard devices including graphics capability Also described are the software configuration of the DAS and complex hardware/software interfaces providing for example automatic amplifier gain and offset adjustment for each data channel Specific DAS applications are summarized including the real time processing of dynamic deflection data unsteady pressure measurements and flutter and buffet data J A M

N79-21098# Aeronautical Research Labs Melbourne (Australia)
A SIMPLE METHOD OF ADAPTING A WIND TUNNEL SCHLIEREN SYSTEM FOR INTERFEROMETRY
N Pollock Jun 1978 38 p refs
(ARL-Aero Note-378 AR-001-281) Avail NTIS HC A03/MF A01

A simple method of adapting a wind tunnel Schlieren system for interferometry is described This new interferometer arrangement employs a laser light source a lens which splits off the reference beam after test beam expansion and a lens and Lloyd mirror to recombine the two beams The reference beam passes through the test section but is contracted to a narrow waist and displaced well away from the model location The proposed design combines a number of favorable characteristics which render it particularly useful for wind tunnel tests These characteristics include simplicity optical robustness low vibration sensitivity modest coherence requirements and ease of interferogram analysis The main disadvantage is that slightly less than half of the total field of view can be recorded on a single interferogram Interferograms obtained from tests on a prototype instrument based on a Schlieren system of low mechanical rigidity are presented A comparison between aerofoil pressure distributions obtained by direct measurement and by interferogram analysis is reported Author

N79-21100# AeroVironment Inc Pasadena Calif
EVALUATION OF EMISSION CONTROL STRATEGIES FOR AIRFIELD OPERATIONS AT THE LOS ANGELES AND SAN FRANCISCO INTERNATIONAL AIRPORTS Final Report
C Gary Gelinas Aug 1978 110 p refs Sponsored by California Air Resources Board
(PB-289622/3 AV-FR-8059) Avail NTIS HC A06/MF A01 CSCL 01E

Potential air pollutant emission reductions which could be achieved by various strategies to control airfield operations at Los Angeles and San Francisco International Airports are reviewed Safety problems cost impacts potential fuel savings time frame for strategy implementation and potential regulatory and jurisdictional conflicts associated with each strategy are among the factors considered Airfield emission sources studied included aircraft operation in the idle taxi takeoff and landing modes ground service vehicles fuel handling and storage and aircraft engine maintenance GRA

N79-21183*# National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston Tex
SURFACE FINISHING Patent Application
Jack A Kinzler James T Heffernan Leroy G Fehrenkamp and William S Lee inventors (to NASA) Filed 25 Jan 1979 26 p
(NASA Case-MSC-12631-3 US-Patent-Appl-SN 006952) Avail NTIS HC A03/MF A01 CSCL 11F

A manufacturing process is described which reduces or eliminates air turbulence created by surface irregularities in metal airfoils due to rivets wrinkles or butt joints The metal surface of the airfoil is cleaned then coated with a thin layer of a fluid adhesive over which a sheet of thin plastic film is stretched Tension is applied to the film and the resultant surface is then squeezed to cause the adhesive to conform to the irregularities remove any bubbles and smooth out any wrinkles in the film The adhesive is then allowed to set The resulting surface is smooth and relatively free of the normal irregularities present in the standard metal airfoil particularly for low speed aircraft
NASA

N79-21201# Royal Aircraft Establishment Farnborough (England)
RAIN-EROSION RESISTANT MATERIALS IN AIR AND SPACE TRAVEL
Dec 1978 17 p refs Transl into ENGLISH from West German report MBB WF-Information 5/78 1978 p 2-10
(RAE-Lib-Trans-2003 BR67275) Avail NTIS HC A02/MF A01

The development of rain erosion resistant protective coatings for radomes is described for use in subsonic applications on aircraft and for supersonic applications on missiles at velocities up to Mach 6 The associated requirements for antistatic antiflash and ablation on the re entry of missiles are also considered Tests (mostly in the USA) are discussed and examples given of suitable materials for each application Some flight experience with erosion damage sustained on Starfighters of the Federal German Air Force is included A R H

N79-21222# Ogden Air Logistics Center Hill AFB Utah Engineering Div
COLD WEATHER ENVIRONMENTAL GROUND STARTING TEST USING JPT-8 IN EGLIN CLIMATIC CHAMBER Report 12 Jun - 18 Aug 1978
T Mitsunaga 25 Oct 1978 88 p
(AD-A063377) Avail NTIS HC A05/MF A01 CSCL 21/5

The purpose of the ground test was to determine if there was any degradation to the F-4 ground start during cold weather with the aircraft serviced with JP 8 fuel Also several proposals for improving the F-4 low temperature starting capability were tested Various combinations of fuel JP-4 and JP-8 and engine specific gravity settings 78 and 82 were tested to simulate actual field situations GRA

N79-21422*# National Aeronautics and Space Administration Langley Research Center Hampton Va
RECENT ADVANCES IN STRUCTURES FOR HYPERSONIC FLIGHT PART 1
1978 533 p refs Symp held at Hampton Va 6 8 Sep 1978
(NASA-CP-2065-Pt-1 L-12653 Pt-1) Avail NTIS HC A23/MF A01 CSCL 20K

The structures technology required for hypersonic cruise vehicles is reviewed Engine structures and cooled airframe structures are emphasized

N79 21423*# National Aeronautics and Space Administration Langley Research Center Hampton Va
HYPERSONIC STRUCTURES AN AERODYNAMICIST S PERSPECTIVE OR ONE MAN S DREAM IS ANOTHER MAN'S NIGHTMARE
J D Watts L R Jackson and J L Hunt *In its* Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 5-38

Avail NTIS HC A23/MF A01 CSCL 20K

The relationship between hypersonic aerodynamic and structural design is reviewed The evolution of the hypersonic vehicle design is presented Propulsion systems structural materials and fuels are emphasized J M S

N79-21424*# National Aeronautics and Space Administration Langley Research Center Hampton Va

AIRFRAME-INTEGRATED PROPULSION SYSTEM FOR HYPERSONIC CRUISE VEHICLES
Robert A Jones and Paul W Huber *In its* Recent Advan in Structures for Hypersonic Flght Pt 1 1978 p 39 45 refs Presented at the 11th Congr of the Intern Council of the Aeron Sci Lisbon 10 16 Sep 1978

Avail NTIS HC A23/MF A01 CSCL 20K

Research on a new hydrogen burning airbreathing engine concept which offers good potential for efficient hypersonic cruise vehicles is considered Features of the engine which lead to good performance include extensive engine-airframe integration fixed geometry low cooling and the control of heat release in the supersonic combustor by mixed-modes of fuel injection from the combustor entrance The engine concept is described along with results from inlet tests direct connect combustor tests and tests of two subscale boiler plate research engines presently underway at conditions which simulate flight at Mach 4 and 7 J M S

N79-21425*# National Aeronautics and Space Administration Langley Research Center Hampton Va
RECENT ADVANCES IN CONVECTIVELY COOLED ENGINE AND AIRFRAME STRUCTURES FOR HYPERSONIC FLIGHT
H Neale Kelly Allan R Wieting Charles P Shore and Robert J Nowak *In its* Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 47 61 refs Presented at the 11th Congr of the Intern Council of the Aeron Sci Lisbon 10 16 Sep 1978

Avail NTIS HC A23/MF A01 CSCL 20K

A hydrogen cooled structure for a fixed geometry airframe-integrated scramjet is described The thermal/structural problems concepts design features and technological advances are applicable to a broad range of engines Convectively cooled airframe structural concepts that have evolved from an extensive series of investigations the technology developments that have led to these concepts and the benefits that accrue from their use are discussed J M S

N79-21426*# AiResearch Mfg Co Los Angeles Calif
DESIGN AND ANALYSIS OF A SCRAMJET ENGINE
O A Buchmann *In* NASA Langley Res Center Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 65-119
(Contract NAS1-13984)

Avail NTIS HC A23/MF A01 CSCL 20K

Design concepts defined for the cooled-structures assembly of a hydrogen fueled regeneratively cooled airframe-integrated Scramjet engine are considered Engine subsystems in particular the fuel subsystem associated with the operating engine are included along with the engine mounting and the interfacing with the airplane The engine structure and thermal protection system including the fuel injection struts are emphasized J M S

N79-21427*# National Aeronautics and Space Administration Langley Research Center Hampton Va
THERMOSTRUCTURAL ANALYSIS OF A SCRAMJET FUEL-INJECTION STRUT
Allan R Wieting and Earl A Thornton (Old Dominion Univ) *In its* Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 120 144 refs

Avail NTIS HC A23/MF A01 CSCL 20K

Results of a thermal/structural design analysis study of a fuel injection strut for an airframe integrated hydrogen cooled scramjet are presented It is indicated that a feasible thermal/structural concept has been identified for the static load conditions and that thermal stresses dominate the response It is suggested that the response of the concept to dynamic loads be investigated J M S

N79-21428*# AiResearch Mfg Co Los Angeles Calif
ADVANCED FABRICATION TECHNIQUES FOR COOLED ENGINE STRUCTURES
O A Buchmann *In* NASA Langley Res Center Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 145-194

(Contract NAS1-14180)
Avail NTIS HC A23/MF A01 CSCL 20K

An improved design for regeneratively cooled engine structures was identified This design uses photochemically machined (PCM) coolant passages It permits the braze joint to be placed in a relatively cool area remote from the critical hot face sheet The geometry of the passages at the face sheet also minimizes stress concentration and therefore enhances the low cycle fatigue performance The two most promising alloys identified for this application are Inconel 617 and Nickel 201 Inconel 617 was selected because it has excellent creep rupture properties while Nickel 201 was selected because of its predicted good performance under low cycle fatigue loading The fabrication of the PCM coolant passages in both Inconel 617 and Nickel 201 was successfully developed During fabrication of Inconel 617 undesirable characteristics were observed in the braze joints A development program to resolve this condition was undertaken and led to definition of an isothermal solidification process for joining Inconel 617 panels This process produced joints which approach parent metal strength and homogeneity J M S

N79-21430*# Bell Aerospace Textron Buffalo N Y
DESIGN AND FABRICATION OF A SKIN STRINGER DISCRETE TUBE ACTIVELY COOLED STRUCTURAL PANEL
Frank M Anthony *In* NASA Langley Res Center Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 253-318 refs
(Contract NAS1-12806)

Avail NTIS HC A23/MF A01 CSCL 20K

The design optimization and practical implementation of actively cooled structural panel concepts was investigated The desired actively cooled structural panel consisted of the cooled skin and a substructure The primary load carrying components were fabricated from 2024-T3 aluminum alloy The 3003-H14 coolant passage tubing was chosen because of its excellent corrosion resistance workability needed to obtain the desired cross sectional shape and strength The Epon 951 adhesive was selected for its excellent structural properties and is the thinnest of available films 0 064 mm The Eccobond 58C silver filled epoxy was chosen because of its high thermal conductivity and the alumina filled Epon 828 was chosen for structural and expansion characteristics J M S

N79-21431*# Rockwell International Corp Downey Calif
DESIGN AND ANALYSIS OF A PLATE-FIN SANDWICH ACTIVELY COOLED STRUCTURAL PANEL
L M Smith *In* NASA Langley Res Center Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 319-373 refs

(Contract NAS1-13382)
Avail NTIS HC A23/MF A01 CSCL 20K

The skin structure of hydrogen fueled hypersonic transport vehicles traveling at Mach 6 and above must be designed to withstand for relatively long periods of time the aerodynamic heating effects which are far more severe than those encountered by the supersonic aircraft of today The use of conventional aircraft materials such as aluminum in combination with forced convection active cooling to accommodate aerodynamic heating is addressed The basic active cooling concept consists of a stringer stiffened plate fin sandwich The sandwich surface is subjected to the aerodynamic heat flux which is transferred via convection to a coolant that is forced through the sandwich under pressure The coolant in turn circulates in a closed loop through a hydrogen heat exchanger and back through the skin panel J M S

N79-21432*# Rockwell International Corp Downey Calif Space Systems Group
FLUXLESS BRAZING AND HEAT TREATMENT OF A PLATE-FIN SANDWICH ACTIVELY COOLED PANEL

Charles S Beuyukian *In* NASA Langley Res Center Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 375-448

Avail NTIS HC A23/MF A01 CSCL 20K

The processes and techniques used to fabricate plate-fin sandwich actively cooled panels are presented The materials were 6061 aluminum alloy and brazing sheet having clad brazing alloy The panels consisted of small scale specimens fatigue specimens and a large 0 61 m by 1 22 m test panel All panels were fluxless brazed in retorts in heated platen presses while exerting external pressure to assure intimate contact of details Distortion and damage normally associated with that heat treatment were minimized by heat treating without fixtures and solution quenching in an organic polymer solution The test panel is the largest fluxless brazed and heat treated panel of its configuration known to exist J M S

N79-21433*# McDonnell Aircraft Co St Louis Mo
DESIGN AND FABRICATION OF A RADIATIVE ACTIVELY COOLED HONEYCOMB SANDWICH PANEL
Leland C Koch *In* NASA Langley Res Center Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 449-492 refs
Avail NTIS HC A23/MF A01 CSCL 20K

The mass of a radiative actively cooled panel was compared to the mass of a bare actively cooled panel designed to the same conditions and constraints The approach was to design and optimize a 0 61 x 6 1 m full scale panel which combines radiative and active cooling to control structural temperatures to levels compatible with use of lightweight materials and to fabricate a 0 61 x 1 22 m panel for performance testing Results of the design and optimization of the full scale radiative actively cooled structural panel including radiative concept selection final configuration details test panel description and conclusions are summarized J M S

N79-21434*# National Aeronautics and Space Administration Langley Research Center Hampton Va
RADIATIVE ACTIVELY COOLED PANEL TESTS RESULTS
Charles P Shore Robert J Nowak and Ellsworth L Sharpe *In its* Recent Advan in Structures for Hypersonic Flight Pt 1 1978 p 493-536 refs
Avail NTIS HC A23/MF A01 CSCL 20K

The radiative actively cooled panel designed to withstand a uniform incident heat flux of 136 kW/sq m to a 444 K surface temperature was evaluated The test program consisted of preliminary static thermal mechanical loading and aerothermal flow tests Test results are briefly discussed J M S

N79-21435*# National Aeronautics and Space Administration Langley Research Center Hampton Va
RECENT ADVANCES IN STRUCTURES FOR HYPERSONIC FLIGHT PART 2
1978 408 p refs Symp held at Hampton Va 6-8 Sep 1978
(NASA-CP-2065 Pt-2 L-12653 Pt-2) Avail NTIS HC A18/MF A01 CSCL 20K

The papers at this symposium were presented by 24 speakers representing airframe missile and engine manufacturers the U S Air Force and two NASA Research Centers The papers cover a variety of topics including engine structures cooled airframe structures hot structures thermal protection systems cryogenic tankage structures cryogenic insulations and analysis methods for thermal/structures

N79-21436*# National Aeronautics and Space Administration Langley Research Center Hampton Va
TESTS OF BEADED AND TUBULAR STRUCTURAL PANELS
John L Shideler Roger A Fields and Lawrence F Reardon *In its* Recent Advan in Structures for Hypersonic Flight Pt 2 1978 p 538-576 refs Prepared in cooperation with NASA/Dryden Flight Res Center
Avail NTIS HC A18/MF A01 CSCL 20K

Two efficient concepts built from curved elements were identified and a data base for tubular panels was developed The tubular panel failure modes were understood and the data base for these panels indicated that their performance can be predicted The concepts are currently being tested in a realistic builtup structure 157 room temperature tests and 67 hot tests were made with no structural failures although all of these tests were not at the design load of the structure J A M

N79-21437*# Applied Physics Lab Johns Hopkins Univ Laurel Md
STRUCTURES FOR HYPERSONIC AIRBREATHING TACTICAL MISSILES
William C Caywood and Richard M Rivello *In* NASA Langley Res Center Recent Advan in Structures for Hypersonic Flight Pt 2 1978 p 577-599 Sponsored in part by Navy

Avail NTIS HC A18/MF A01 CSCL 20K

The studies to date were encouraging and indicated that materials were available or could be developed to satisfy scramjet requirements Some of the more promising materials for the critical components were indicated This information is summarized as follows (1) radome - Slip cast fused silica is the current candidate but others are being investigated One shortcoming of slip cast fused silica is its susceptability to rain damage (2) inlet leading edges - A refractory metal with a good oxidation protective coating will be required Tantalum T222 with a Hafnia coating looks promising (3) inlet ducts - An uninsulated refractory alloy will be required Columbium F-85 was the best of those considered for the noncircular ducts (4) external body - The external body temperatures are sufficiently low to permit the use of super alloys (5) combustor and nozzle - The pyrolytic graphite/silicon carbide coating is very attractive for use in the combustor and nozzle areas J A M

N79-21438*# Rockwell International Corp Los Angeles Calif
STRUCTURES AND TPS FOR THE NHFRF/HYTID
Harvey J Hoge *In* NASA Langley Res Center Recent Advan in Structures for Hypersonic Flight Pt 2 1978 p 601 627 refs
Avail NTIS HC A18/MF A01 CSCL 20K

The goal of HYTID was to provide a cost effective hypersonic vehicle constructed of near-state-of art systems and structure with sufficient margins to assure no vehicle flight development problems and to permit concentration of flight operations on hypersonic research with a broad series of experiments carried in a dedicated payload bay or on the exposed surface of the lower aft fuselage J A M

N79-21447# National Aerospace Lab Amsterdam (Netherlands)
EFFECT OF FLIGHT LOAD SPECTRUM VARIATIONS ON FATIGUE LIFE OF RIVETED SPECIMENS AND CRACK PROPAGATION IN SHEET MADE OF ALCLAD 7076-T6
J B DeJonge A Nederveen and P J Tromp 22 Jun 1978 57 p refs
(NLR-TR-78071-UCICAF-1060) Avail NTIS HC A04/MF A01

Riveted specimens that are considered representative for F-27 type wing structure were subjected to comparative flight simulation tests in which the gust load severity and Ground Air-Ground cycle were systematically varied The effect of these variations on crack propagation behaviour was studied by means of crack growth tests on 2 mm sheet specimens of 7075 T6 clad material provided with a central sawout Author

N79-21448# National Aerospace Lab Amsterdam (Netherlands)
REVIEW OF AERONAUTICAL FATIGUE INVESTIGATIONS IN THE NETHERLANDS DURING THE PERIOD MARCH 1977 - FEBRUARY 1979
J Schijve ed Feb 1979 41 p refs Presented at the 16th ICAF Conf Brussels 14-15 May 1979
(NLR-MP-79006-UCICAF-1081) Avail NTIS HC A03/MF A01

The topics of the investigation reports are loads flight simulation testing fatigue investigations residual strength and FEM calculations materials evaluation fatigue crack growth and fatigue of aircraft structure and materials M M M

N79-21449# National Aerospace Lab Amsterdam (Netherlands)
THE EFFECT OF SHEET EDGE WORKING ON THE FATIGUE LIFE UNDER FLIGHT-SIMULATION LOADING
F A Jacobs J Schijve and P J Tromp Jul 1977 30 p refs
(NLR-TR-77095-U) Avail NTIS HC A03/MF A01

Fatigue tests under flight simulation loading were performed on unnotched Alclad 2024 T3 anodised 2 0 mm thick sheet specimens manufactured according to several machine shop processes applied in the aircraft industry From the results it appears that milling is preferable to stamping Rounding off the edges is also advantageous The effect of anodizing is detrimental Author

N79-21868*# National Aeronautics and Space Administration Langley Research Center Hampton Va
PRELIMINARY NOISE TRADEOFF STUDY OF A MACH 2 7 CRUISE AIRCRAFT
V R Mascitti D J Maglieri ed and J P Raney ed Apr 1979 50 p refs
(NASA-TM-78732) Avail NTIS HC A03/MF A01 CSCL 20A

NASA computer codes in the areas of preliminary sizing and enroute performance takeoff and landing performance aircraft noise prediction and economics were used in a preliminary noise tradeoff study for a Mach 2 7 design supersonic cruise concept Aerodynamic configuration data were based on wind-tunnel model tests and related analyses Aircraft structural characteristics and weight were based on advanced structural design methodologies assuming conventional titanium technology The most advanced noise prediction techniques available were used and aircraft operating costs were estimated using accepted industry methods The 4-engines cycles included in the study were based on assumed 1985 technology levels Propulsion data was provided by aircraft manufacturers Additional empirical data is needed to define both noise reduction features and other operating characteristics of all engine cycles under study Data on VCE design parameters coannular nozzle inverted flow noise reduction and advanced mechanical suppressors are urgently needed to reduce the present uncertainties in studies of this type A R H

N79-21869*# National Aeronautics and Space Administration Langley Research Center Hampton Va
NOISE AND PERFORMANCE CALIBRATION STUDY OF A MACH 2 2 SUPERSONIC CRUISE AIRCRAFT
V R Mascitti and D J Maglieri Jan 1979 26 p ref
(NASA-TM 80043) Avail NTIS HC A03/MF A01 CSCL 20A

The baseline configuration of a Mach 2 2 supersonic cruise concept employing a 1980 - 1985 technology level dry turbojet mechanically suppressed engine was calibrated to identify differences in noise levels and performance as determined by the methodology and ground rules used In addition economic and noise information is provided consistent with a previous study based on an advanced technology Mach 2 7 configuration reported separately Results indicate that the difference between NASA and manufacturer performance methodology is small Resizing the aircraft to NASA groundrules results in negligible changes in takeoff noise levels (less than 1 EPNdB) but approach noise is reduced by 5 3 EPNdB as a result of increasing approach speed For the power setting chosen engine oversizing resulted in no reduction in traded noise In terms of summated noise level a 6 EPNdB reduction is realized for a 5% increase in total operating costs A R H

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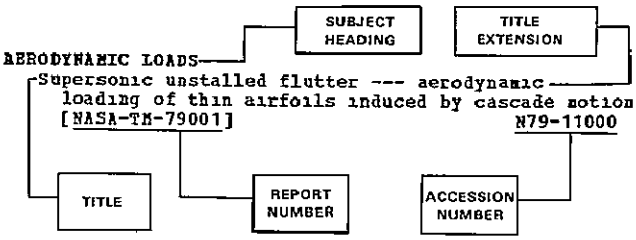

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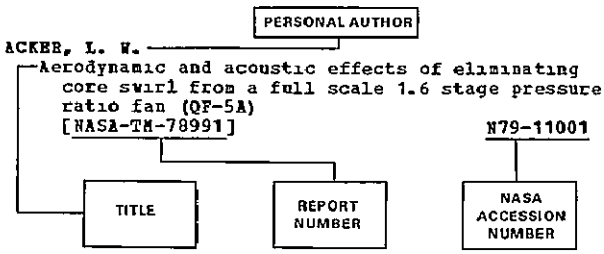

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