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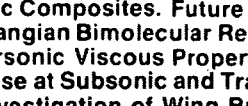


1981

Ames Research Center Publications: A Continuing Bibliography

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ulation of the Tilt Rotor Concept: The XV-15's Role. Future Requirements and Roles of Computers in Aerodynamic
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 Augmented Jet Flap STOL Airplane. G-Seat System Step Input and Sinusoidal Response Characteristic
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 -15 Tilt Rotor Aircraft in Helicopter Mode. Application of Advanced Technologies to Small Short-Haul A
 Large Scale Swivel Nozzle Thrust Deflector. High Angle Canard Missile Test in the Ames 11-Foot Tran
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 mputation of Inviscid Compressible Flows. Engineering Tests of the C-141 Telescope. Calculation of Supersonic Viscous Properties of
 amic Characteristics of an 0.075-Scale F-15 Airplane Model at High Angles of Attack and Sideslip. Response at Subsonic and Transon
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1981

Ames Research Center Publications: A Continuing Bibliography



National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, California 94035

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INTRODUCTION

The *Ames Research Center Publications: A Continuing Bibliography* contains the research output of the Center indexed during 1981 in *Scientific and Technical Aerospace Reports* (STAR), *Limited Scientific and Technical Aerospace Reports* (LSTAR), *International Aerospace Abstracts* (IAA), and *Computer Program Abstracts* (CPA). This bibliography is published annually in an attempt to effect greater awareness and distribution of the Center's research output.

For 1981, the output of the Ames Research Center included 20 NASA Formal Reports, 84 NASA Quick-Release Technical Memorandums, 179 NASA Contractor Reports, 181 Journal Articles and Chapters in Books, 140 Conference/Meeting Papers, and 13 Patents. The citations are listed by Division or Office and then under the following headings: NASA Formal Reports; NASA Technical Memoranda; NASA Contractor Reports; Journal Articles, Books, and Chapters in Books; Conference/Meeting Papers; and Patents.

The *Continuing Bibliography* will cease as a formal publication with the 1981 edition. It will be replaced with a report slightly different in purpose and content. This year marks the period of transition. Several features which appeared previously have been deleted from the 1981 edition. The subject, author, contract number, and report number indexes have been deleted. The external distribution of the report has been limited. Abstracts have been retained but will not appear in future issues.

A publication of this magnitude requires the efforts of many individuals. Special recognition is given to Marilyn Bonner, Susie Rydquist, Marianne Rudolph, Carol Sherman, and Betty Sherwood who were responsible for compiling the bibliography and ensuring the accuracy of citations assigned to the various divisions and offices. Finally, a note of thanks and appreciation to the Publications Branch of the Langley Research Center where the report was printed so expeditiously.

AVAILABILITY

Availability sources of the different output categories are given below:

Category	Source
NASA Report Literature:	National Technical Information Service (NTIS) 5285 Port Royal Road Springfield, VA 22161
Formal Reports	NASA Scientific and Technical Information Facility (STIF) P.O. Box 8757 Baltimore/Washington International Airport, MD 21240
Technical Memoranda	NASA Industrial Applications Centers (IAC)
Contractor Reports	Consult citation for source of availability
Journal Articles, Chapters in Books, and Conference/Meeting Papers	Computer Software Management and Information Center (COSMIC) 112 Barrow Hall University of Georgia Athens, GA 30601
Patents:	National Technical Information Service (NTIS) Commissioner of Patents and Trademarks U.S. Patent and Trademark Office Washington, DC 20231
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OFFICE OF THE DIRECTOR

NASA FORMAL REPORTS

N81-31185*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

VEHICLE CONCEPTS AND TECHNOLOGY REQUIREMENTS FOR BUOYANT HEAVY-LIFT SYSTEMS

Mark D. Ardema Sep. 1981 18 p refs
(NASA-TP-1921; A-8022) Avail: NTIS HC A02/MF A01 CSCL 01C

Several buoyant-vehicle (airship) concepts proposed for short hauls of heavy payloads are described. Numerous studies identified operating cost and payload capacity advantages relative to existing or proposed heavy-lift helicopters for such vehicles. Applications involving payloads of from 15 tons up to 800 tons were identified. The buoyant quad-rotor concept is discussed in detail, including the history of its development, current estimates of performance and economics, currently perceived technology requirements, and recent research and technology development. It is concluded that the buoyant quad-rotor, and possibly other buoyant vehicle concepts, has the potential of satisfying the market for very heavy vertical lift but that additional research and technology development are necessary. Because of uncertainties in analytical prediction methods and small-scale experimental measurements, there is a strong need for large or full-scale experiments in ground test facilities and, ultimately, with a flight research vehicle.

Author

NASA TECHNICAL MEMORANDA

N81-18023*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CIVIL MARKETS FOR BUOYANT HEAVY-LIFT VEHICLES

Peter J. Mettam (Booz, Allen and Hamilton, Bethesda, Md.), Dagfin Hansen (Booz, Allen and Hamilton, Bethesda, Md.), and Mark D. Ardema Mar. 1981 36 p refs
(NASA-TM-81270) Avail: NTIS HC A03/MF A01 CSCL 01B

Worldwide civil markets for heavy lift airships were investigated. Substantial potential market demand was identified for payloads of from 13 to 800 tons. The largest markets appear to be in applications to relieve port congestion, construction of power generating plants, and, most notably, logging. Because of significant uncertainties both in vehicle and market characteristics, further analysis will be necessary to verify the identified market potential of heavy lift airship concepts.

A.R.H.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-27889 * Wing flapping with minimum energy. R. T. Jones (NASA, Ames Research Center, Moffett Field, Calif.). *Aeronautical Journal*, vol. 84, July 1980, p. 214-217.

A technique employed by Prandtl and Munk is adapted for the case of a wing in flapping motion to determine its lift distribution. The problem may be reduced to one of minimizing induced drag for a specified and periodically varying bending moment at the wing root. It is concluded that two wings in close tandem arrangement, moving in opposite phase, would eliminate the induced aerodynamic losses calculated.

O.C.

D

PUBLIC AFFAIRS OFFICE

CONFERENCE AND MEETING PAPERS

N81-32564*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FIELD STUDY FOR REMOTE SENSING: AN INSTRUCTOR'S MANUAL

William H. Wake, ed. (California State Coll., Bakersfield) and Garth A. Hull, ed. 1981 93 p refs Proceedings of the

LANDSAT C Educator's/User's Workshop, Santa Maria, Calif., 2-4 Mar. 1978; sponsored by the National Council for Geographic Education and Univ. of Western Illinois, Macomb
(NASA-CP-2155; A-8336; LC-78-61696) Avail: NTIS HC A05/MF A01 CSCL 05I

The need for and value of field work (surface truthing) in the verification of image identification from high altitude infrared and multispectral space sensor images are discussed in this handbook which presents guidelines for developing instructional and research procedures in remote sensing of the environment. For individual titles, see N81-32565 through N81-32572.

OFFICE OF THE DIRECTOR OF ADMINISTRATION

NO PUBLICATIONS

TECHNICAL INFORMATION DIVISION

NASA TECHNICAL MEMORANDA

N81-17944*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

THE 1979 AMES RESEARCH CENTER PUBLICATIONS: A CONTINUING BIBLIOGRAPHY

1979 319 p
(NASA-TM-81257; A-8431) Avail: NTIS HC A14/MF A01
CSCL 05B

This bibliography lists formal NASA publications, journal articles, books, chapters of books, patents, and contractor reports issued by Ames Research Center which were indexed by Scientific and Technical Aerospace Reports, Limited Scientific and Technical Aerospace Reports, and International Aerospace Abstracts in 1979. Citations are arranged by directorate, type of publication, and NASA accession numbers. Subject, Personal Author, Corporate Source, Contract Number, and Report/Accession Number Indexes are provided. Author

N81-34138*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

AMES RESEARCH CENTER PUBLICATIONS: A CONTINUING BIBLIOGRAPHY, 1981

Aug. 1981 261 p
(NASA-TM-81308; A-8655) Avail: NTIS HC A12/MF A01
CSCL 05B

This bibliography lists formal NASA publications, journal articles, books, chapters of books, patents, contractor reports, and computer programs that were issued by Ames Research Center and indexed by Scientific and Technical Aerospace Reports, Limited Scientific and Technical Aerospace Reports, International Aerospace Abstracts, and Computer Program Abstracts in 1980. Citations are arranged by directorate, type of publication, and NASA accession numbers. Subject, personal author, corporate source, contract number, and report/accession number indexes are provided. A.R.H.

A

TECHNOLOGY UTILIZATION OFFICE

NASA CONTRACTOR REPORTS

N81-27981*# SRI International Corp., Menlo Park, Calif.

TECHNOLOGY TRANSFER: TRANSPORTATION Annual Report, 1 Jan. 1978 - 31 Dec. 1978

Tom Anyos, Lo Christy, Ruth Lizak, and James Wilhelm 31 Dec. 1978 98 p refs

(Contract NAS2-9846)

(NASA-CR-152673) Avail: NTIS HC A05/MF A01 CSCL 05A

The successful application of aerospace technology to problems related to highways and rail and rapid transit systems is described with emphasis on the use of corrosion resistant paints, fire retardant materials, and law enforcement. Possible areas for the use of spinoff from NASA technology by the California State Department of Corrections are identified. These include drug detection, security and warning systems, and the transportation and storage of food. A communication system for emergency services is also described. A.R.H.

N81-29526*# SRI International Corp., Menlo Park, Calif.

AN ANALYSIS OF SOLAR PANEL ASSEMBLY AS A PRISON INDUSTRY

Ruth M. Lizak Nov. 1980 84 p refs
(Contract NAS2-10143; SRI Proj. 8134)

(NASA-CR-166158) Avail: NTIS HC A05/MF A01 CSCL 10A

An analysis of the effect of manufacturing solar collectors by California prison inmates is presented. It was concluded that the concept is feasible and would have little adverse effect on the private sector's solar industry. L.F.M.

N81-30048*# SRI International Corp., Menlo Park, Calif.

OBSTACLE DETECTORS FOR AUTOMATED TRANSIT VEHICLES: A TECHNOECONOMIC AND MARKET ANALYSIS

Charles E. Lockerby Dec. 1979 51 p refs

(Contract NAS2-10143; SRI Proj. 8134)

(NASA-CR-164661) Avail: NTIS HC A04/MF A01 CSCL 13F

A search was conducted to identify the technical and economic characteristics of both NASA and nonNASA obstacle detectors. The findings, along with market information were compiled and analyzed for consideration by DOT and NASA in decisions about any future automated transit vehicle obstacle detector research, development, or applications project. Currently available obstacle detectors and systems under development are identified by type (sonic, capacitance, infrared/optical, guided radar, and probe contact) and compared with the three NASA devices selected as possible improvements or solutions to the problems in existing obstacle detection systems. Cost analyses and market forecasts individually for the AGT and AMTV markets are included. A.R.H.

N81-31035*# University of Southern California, Los Angeles.
NASA Industrial Application Center.

**ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 1:
PROJECT SUMMARY AND PROCEDURES**

D. H. Maund [1981] 54 p refs 4 Vol.

(Contract NAS2-10794)

(NASA-CR-166238-Vol-1; DRB-320-Vol-1) Avail: NTIS
HC A04/MF A01 CSCL 13B

The Advanced Technology Display House (ATDH) project is described. Tasks are defined in the areas of energy demand, water demand, sewage treatment, electric power, plumbing, lighting, heating, and air conditioning. Energy, water, and sewage systems are defined. S.F.

N81-31036*# University of Southern California, Los Angeles.
NASA Industrial Application Center.

**ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 2:
ENERGY SYSTEM DESIGN CONCEPTS**

D. H. Maund [1981] 62 p refs 4 Vol.

(Contract NAS2-10794)

(NASA-CR-166238-Vol-2; DRB-320-Vol-2) Avail: NTIS
HC A04/MF A01 CSCL 13B

The preliminary design concept for the energy systems in the Advanced Technology Display House is analyzed. Residential energy demand, energy conservation, and energy concepts are included. Photovoltaic arrays and REDOX (reduction oxidation) sizes are discussed. S.F.

N81-31037*# University of Southern California, Los Angeles.
NASA Industrial Application Center.

**ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 3:
WATER AND SEWER DESIGN CONCEPTS**

D. H. Maund [1981] 58 p refs 4 Vol.

(Contract NAS2-10794)

(NASA-CR-166238-Vol-3; DRB-320-Vol-3) Avail: NTIS
HC A04/MF A01 CSCL 13B

Preliminary design concepts for water and sewer systems in the Advanced Technology Display House are described. Proposals for on-site waste disposal and water systems are analyzed. S.F.

N81-31038*# University of Southern California, Los Angeles.
NASA Industrial Application Center.

**ADVANCED TECHNOLOGY DISPLAY HOUSE. VOLUME 4:
BIBLIOGRAPHY**

D. H. Maund [1981] 44 p 4 Vol.

(Contract NAS2-10794)

(NASA-CR-166238-Vol-4; DRB-320-Vol-4) Avail: NTIS
HC A03/MF A01 CSCL 13B

A bibliography is presented for the Advanced Technology Display House. Information sources used in generating the design concepts studied are included. S.F.

A

OFFICE OF THE DIRECTOR OF AERONAUTICS AND FLIGHT SYSTEMS

NO PUBLICATIONS

AERODYNAMICS DIVISION

NASA FORMAL REPORTS

N81-22018*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

NUMERICAL SIMULATION OF STEADY SUPERSONIC FLOW

Lewis B. Schiff and Joseph L. Steger May 1981 42 p refs
(NASA-TP-1749; A-7923) Avail: NTIS HC A03/MF A01 CSCL 01A

A noniterative, implicit, space-marching, finite-difference algorithm was developed for the steady thin-layer Navier-Stokes equations in conservation-law form. The numerical algorithm is applicable to steady supersonic viscous flow over bodies of arbitrary shape. In addition, the same code can be used to compute supersonic inviscid flow or three-dimensional boundary layers. Computed results from two-dimensional and three-dimensional versions of the numerical algorithm are in good agreement with those obtained from more costly time-marching techniques.

Author

NASA TECHNICAL MEMORANDA

X81-10004*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

AERODYNAMIC CHARACTERISTICS OF A 0.1-SCALE MODEL OF A 2-PLACE A-10A AIRCRAFT

John L. Holmberg and Douglas F. Pena (ARO, Inc., Moffett Field, Calif.) Dec. 1980 220 p refs
(NASA-TM-81214; A-8241)

Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

A 0.1 scale model of a two-place version of the A-10A close support aircraft was tested in the Ames 12-Foot Pressure Wind Tunnel. Static stability, control and performance data were obtained to be used in assessing changes to the canopy, vertical tail, engine nacelles and wing trailing edge camber. Angle of attack was varied from -4 deg to 25 deg at sideslip angles of 0 deg and 6 deg and sideslip angle was varied from -16 deg to 8 deg at an angle of attack of 6 deg. Test Mach numbers ranged from 0.225 to 0.7 at unit Reynolds numbers varying between 6.56 and 8.37 million per meter (2.0 and 2.55 million per foot). The incremental effects on longitudinal and lateral aerodynamic characteristics associated with combinations of the component changes were minimal or as expected over the ranges of conditions tested.

T.M.

N81-10054*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

THE XV-15 TILT ROTOR RESEARCH AIRCRAFT

Daniel C. Dugan, Ronald G. Erhart (Bell Helicopter Textron, Fort Worth, Tex.), and Laurel G. Schroers (AVRADCOM) Sep. 1980 21 p refs Prepared in cooperation with AVRADCOM
(NASA-TM-81244; AVRADCOM-TR-80-A-15; A-8343) Avail: NTIS HC A02/MF A01 CSCL 01C

The design characteristics of the XV-15 Tilt rotor research aircraft are presented. Particular attention is given to the following: control system; conversion system; and propulsion system. Flight test results are also reported.

R.C.T.

N81-14981*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL AERODYNAMIC CHARACTERISTICS OF TWO V/STOL FIGHTER/ATTACK AIRCRAFT CONFIGURATIONS AT MACH NUMBERS FROM 0.4 TO 1.4

Walter P. Nelms, Donald A. Durston, and J. R. Lummus (General Dynamics, Fort Worth, Tex.) Dec. 1980 529 p refs
(NASA-TM-81234; A-8338) Avail: NTIS HC A23/MF A01 CSCL 01A

A wind tunnel test was conducted to measure the aerodynamic characteristics of two horizontal attitude takeoff and landing V/STOL fighter/attack aircraft concepts. In one concept, a jet diffuser ejector was used for the vertical lift system; the other used a remote augmentation lift system (RALS). Wind tunnel tests to investigate the aerodynamic uncertainties and to establish a data base for these types of concepts were conducted over a Mach number range from 0.2 to 2.0. The present report covers tests, conducted in the 11 foot transonic wind tunnel, for Mach numbers from 0.4 to 1.4. Detailed effects of varying the angle of attack (up to 27 deg), angle of sideslip (-4 deg to +8 deg), Mach number, Reynolds number, and configuration buildup were investigated. In addition, the effects of wing trailing edge flap deflections, canard incidence, and vertical tail deflections were explored. Variable canard longitudinal location and different shapes of the inboard nacelle body strakes were also investigated.

E.D.K.

N81-28055*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

UNPOWERED AERODYNAMIC CHARACTERISTICS OF A 15-PERCENT SCALE MODEL OF A TWIN-ENGINE COMMUTER AIRCRAFT

Daniel G. Morgan, Thomas L. Galloway, and Bruno J. Gambucci (Kendall Associates) Jul. 1981 74 p
(NASA-TM-81284; A-8552) Avail: NTIS HC A04/MF A01 CSCL 01A

An experimental investigation was conducted in the Ames 12-Foot Pressure Wind Tunnel to determine the unpowered aerodynamic characteristics of a 15-percent-scale model of a twin-engine commuter aircraft. Model longitudinal aerodynamic characteristics were examined at discrete flap deflections for various angle-of-attack and wind-tunnel-velocity ranges with the empennage on and off. Data are presented for the basic model configuration consisting of the fuselage, wing, basic wing leading edge, double slotted flaps, midengine nacelles, and empennage. Other configurations tested include a particle-span drooped leading edge (dropped outboard of the engine nacelles), a full-span drooped leading edge, low- and high-mounted engine nacelles, and a single-slotted flap. An evaluation was made of the model mounting system by comparing data obtained with the model mounted conventionally on the wind-tunnel model-support struts and the model inverted. Author

N81-24066* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TOP-MOUNTED INLET SYSTEM FEASIBILITY FOR TRANSONIC-SUPERSONIC FIGHTER AIRCRAFT

T. L. Williams (Northrop Corp., Hawthorne, Calif.), B. L. Hunt (Northrop Corp., Hawthorne, Calif.), D. B. Smeltzer, and W. P. Nelms Apr. 1981 20 p refs
(NASA-TM-81292; A-8575) Avail: NTIS HC A02/MF A01 CSDL 21E

The more salient findings are presented of recent top inlet performance evaluations aimed at assessing the feasibility of top-mounted inlet systems for transonic-supersonic fighter aircraft applications. Top inlet flow field and engine-inlet performance test data show the influence of key aircraft configuration variables-inlet longitudinal position, wing leading-edge extension planform area, canopy-dorsal integration, and variable incidence canards-on top inlet performance over the Mach range of 0.6 to 2.0. Top inlet performance data are compared with those or more conventional inlet/airframe integrations in an effort to assess the viability of top-mounted inlet systems relative to conventional inlet installations. A.R.H.

N81-30083* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL AERODYNAMIC CHARACTERISTICS OF TWO V/STOL FIGHTER/ATTACK AIRCRAFT CONFIGURATIONS AT MACH NUMBERS FROM 1.6 TO 2.0

Walter P. Nelms, Donald A. Durston, and J. R. Lummus (General Dynamic Corp., Fort Worth, Tex.) May 1981 292 p refs
Sponsored in part by the Navy
(NASA-TM-81286; A-8559) Avail: NTIS HC A12/MF A01 CSDL 01A

Tests were conducted in the Ames 9 by 7 ft supersonic wind tunnel to measure the aerodynamic characteristics of two horizontal attitude takeoff and landing V/STOL fighter/attack aircraft concepts. One concept featured a jet diffuser ejector for its vertical lift system and the other employed a remote augmentation lift system (RALS). Test results for Mach numbers from 1.6 to 2.0 are reported. Effects of varying the angle of attack (-4 deg to +17 deg), angle of sideslip (-4 deg to +8 deg) Mach number, and configuration building were investigated. The effects of wing trailing edge flap deflections, canard incidence, and vertical tail deflections were also explored as well as the effects of varying the canard longitudinal location and shapes of the inboard nacelle body strakes. A.R.H.

NASA CONTRACTOR REPORTS

N81-18027* Flow Research, Inc., Kent, Wash.

AERODYNAMIC EFFECTS OF NEARLY UNIFORM SLIPSTREAMS ON THIN WINGS IN THE TRANSONIC REGIME
Final Report

Magdi H. Rizk May 1980 58 p refs

(Contract NAS2-9913)

(NASA-CR-152351) Avail: NTIS HC A04/MF A01 CSDL 01A

A simplified model is used to describe the interaction between a propeller slipstream and a wing in the transonic regime. The undisturbed slipstream boundary is assumed to coincide with an infinite circular cylinder. The undisturbed slipstream velocity is rotational and is a function of the radius only. In general, the velocity perturbation caused by introducing a wing into the slipstream is also rotational. By making small disturbance assumptions, however, the perturbation velocity becomes nearly potential, and an approximation for the flow is obtained by solving a potential equation. A.R.H.

N81-18044* Neilsen Engineering and Research, Inc., Mountain View, Calif.

CONTINUED DEVELOPMENT AND CORRELATION OF ANALYTICALLY BASED WEIGHT ESTIMATION CODES FOR WINGS AND FUSELAGES Contractor Technical Report, Jun. 1975 - May 1976

Joseph Mullen, Jr. Mar. 1978 139 p refs

(Contract NAS2-8558)

(NASA-CR-152331; NEAR-TR-161) Avail: NTIS HC A07/MF A01 CSDL 01C

The implementation of the changes to the program for Wing Aeroelastic Design and the development of a program to estimate aircraft fuselage weights are described. The equations to implement the modified planform description, the stiffened panel skin representation, the trim loads calculation, and the flutter constraint approximation are presented. A comparison of the wing model with the actual F-5A weight material distributions and loads is given. The equations and program techniques used for the estimation of aircraft fuselage weights are described. These equations were incorporated as a computer code. The weight predictions of this program are compared with data from the C-141. T.M.

N81-18045* Neilsen Engineering and Research, Inc., Mountain View, Calif.

DATA BASE FOR THE PREDICTION OF AIRFRAME/PROPULSION SYSTEM INTERFERENCE EFFECTS Final Report, 14 Feb. 1977 - 1 Jan. 1979

Oden J. McMillan, Edward W. Perkins, Gary D. Kuhn, and Stanley C. Perkins, Jr. Nov. 1979 435 p refs

(Contract NAS2-9513)

(NASA-CR-152316; NEAR-TR-187) Avail: NTIS HC A19/MF A01 CSDL 01C

Supersonic tactical aircraft with highly integrated jet propulsion systems were investigated. Primary attention was given to those interference effects which impact the external aerodynamics of the aircraft. R.C.T.

N81-19022* Boeing Commercial Airplane Co., Seattle, Wash.
A HIGHER ORDER PANEL METHOD FOR LINEARIZED SUPERSONIC FLOW

F. Edward Ehlers, Michael A. Epton, Forrester T. Johnson, Alfred E. Magnus, and Paul E. Rubbert May 1979 288 p refs

(Contract NAS2-7729)

(NASA-CR-3082; D6-48058) Avail: NTIS HC A12/MF A01 CSDL 01A

The basic integral equations of linearized supersonic theory for an advanced supersonic panel method are derived. Methods using only linear varying source strength over each panel or only quadratic doublet strength over each panel gave good agreement with analytic solutions over cones and zero thickness cambered wings. For three dimensional bodies and wings of general shape, combined source and doublet panels with interior boundary conditions to eliminate the internal perturbations lead to a stable method providing good agreement experiment. A panel system with all edges contiguous resulted from dividing

the basic four point non-planar panel into eight triangular subpanels, and the doublet strength was made continuous at all edges by a quadratic distribution over each subpanel. Superinclined panels were developed and tested on a simple nacelle and on an airplane model having engine inlets, with excellent results.

Author

N81-23030* General Dynamics Corp., Fort Worth, Tex.
ANALYSIS OF WIND TUNNEL TEST RESULTS FOR A 9.39-PER CENT SCALE MODEL OF A VSTOL FIGHTER/ATTACK AIRCRAFT. VOLUME 1: STUDY OVERVIEW Final Report, 10 Sep. 1979 - 10 Feb. 1981

J. R. Lummus, G. T. Joyce, and C. D. OMalley Oct. 1980 97 p 4 Vol.

(Contract NAS2-10344)

(NASA-CR-152391-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 01A

The ability of current methodologies to accurately predict the aerodynamic characteristics identified as uncertainties was evaluated for two aircraft configurations. The two wind tunnel models studied horizontal altitude takeoff and landing V/STOL fighter aircraft derivatives.

R.C.T.

N81-23033* General Dynamics Corp., Fort Worth, Tex.
ANALYSIS OF WIND TUNNEL TEST RESULTS FOR A 9.39-PER CENT SCALE MODEL OF A VSTOL FIGHTER/ATTACK AIRCRAFT. VOLUME 4: RALS R104 AERODYNAMIC CHARACTERISTICS AND COMPARISONS WITH E205 CONFIGURATION AERODYNAMIC CHARACTERISTICS Final Report, 10 Sep. 1979 - 10 Feb. 1981

J. R. Lummus, G. T. Joyce, and C. D. OMalley Oct. 1980 136 p 4 Vol.

(Contract NAS2-10344)

(NASA-CR-152391-Vol-4) Avail: NTIS HC A07/MF A01 CSCL 01A

The longitudinal and lateral-directional aerodynamic characteristics of the RALS R104 wind tunnel model are summarized. Configurations for the E205 are also presented for comparison.

R.C.T.

N81-23038* Cornell Univ., Ithaca, N. Y. School of Mechanical and Aerospace Engineering.

PREDICTION OF THE TURBULENT WAKE WITH SECOND-ORDER CLOSURE

D. B. Taulbee (State Univ. of New York, Buffalo) and J. L. Lumley May 1981 42 p refs

(Grants NsG-2382; NSF ATM-79-22006; NSF CME-79-19817) (NASA-CR-164294; FDA-81-03) Avail: NTIS

HC A03/MF A01 CSCL 01A

A turbulence was envisioned whose energy containing scales would be Gaussian in the absence of inhomogeneity, gravity, etc. An equation was constructed for a function equivalent to the probability density, the second moment of which corresponded to the accepted modeled form of the Reynolds stress equation. The third moment equations obtained from this were simplified by the assumption of weak inhomogeneity. Calculations are presented with this model as well as interpretations of the results.

E.D.K.

N81-25064* Grumman Aerospace Corp., Bethpage, N.Y.
AXISYMMETRIC & NON-AXISYMMETRIC EXHAUST JET INDUCED-EFFECTS ON A V/STOL VEHICLE DESIGN. PART 1: DATA PRESENTATION Interim Report

W. C. Schnell and G. W. Ordonez 1 May 1981 538 p refs (Contract NAS2-9887)

(NASA-CR-166146; Rept-0747-81-Pt-1) Avail: NTIS HC A23/MF A01 CSCL 01C

A 1/8 scale jet-effects model was tested in the NASA Ames 11 ft transonic tunnel at static conditions and over a range of

Mach numbers from 0.4 to 1.4. The data presented show that significant differences in aeropropulsion performance can be expected by varying the exhaust nozzle type and its geometric parameters on a V/STOL underwing nacelle installation. T.M.

N81-30085* Douglas Aircraft Co., Inc., Long Beach, Calif.
ANALYSIS OF MACH NUMBER 0.8 TURBOPROP SLIP-STREAM WING/NACELLE INTERACTIONS Final Report

H. Robert Welge, Dan H. Neuhart, and John A. Dahlin 6 Aug. 1981 84 p refs

(Contract NAS2-10881)

(NASA-CR-166214; ACEE-25-FR-1564) Avail: NTIS HC A05/MF A01 CSCL 01A

Data from wind tunnel tests of a powered propeller and nacelle mounted on a supercritical wing are analyzed. Installation of the nacelle significantly affected the wing flow and the flow on the upper surface of the wing is separated near the leading edge under powered conditions. Comparisons of various theories with the data indicated that the Neumann surface panel solution and the Jameson transonic solution gave results adequate for design purposes. A modified wing design was developed (Mod 3) which reduces the wing upper surface pressure coefficients and section lift coefficients at powered conditions to levels below those of the original wing without nacelle or power. A contoured over the wing nacelle that can be installed on the original wing without any appreciable interference to the wing upper surface pressure is described.

J.D.H.

N81-32472* Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.

SELF-SYNCHRONIZING SCHLIEREN PHOTOGRAPHY AND INTERFEROMETRY FOR THE VISUALIZATION OF UNSTEADY TRANSONIC FLOWS Final Report

Robert Kadlec 12 Mar. 1979 30 p refs

(Grant NsG-2128)

(NASA-CR-164839) Avail: NTIS HC A03/MF A01 CSCL 14E

The use of self synchronizing stroboscopic Schlieren and laser interferometer systems to obtain quantitative space time measurements of distinguished flow surfaces, streakline patterns, and the density field of two dimensional flows that exhibit a periodic content was investigated. A large field single path stroboscopic Schlieren system was designed, constructed and successfully applied to visualize four periodic flows: near wake behind an oscillating airfoil; edge tone sound generation; 2-D planar wall jet; and axisymmetric pulsed sonic jet. This visualization technique provides an effective means of studying quasi-periodic flows in real time. The image on the viewing screen is a spatial signal average of the coherent periodic motion rather than a single realization, the high speed motion of a quasi-periodic flow can be reconstructed by recording photographs of the flow at different fixed time delays in one cycle. The preliminary design and construction of a self synchronizing stroboscopic laser interferometer with a modified Mach-Zehnder optical system is also reported.

A.R.H.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-11576 * # Three-layer interactive method for computing supersonic laminar separated flows. J. Brandeis (NASA, Ames Research Center, Moffett Field, Calif.; Technion - Israel Institute of Technology, Haifa, Israel) and J. Rom (Technion - Israel Institute of Technology, Haifa, Israel). *AIAA Journal*, vol. 18, Nov. 1980, p. 1320-1327. 14 refs.

An interactive model for numerical computation of complicated two-dimensional flowfields including regions of reversed flow is proposed. The present approach is one of dividing the flowfield into

three regions, in each of which a simplified mathematical model is applied: (1) outer, supersonic flow for which the full potential equation (hyperbolic) is used; (2) viscous, laminar layer in which the compressible boundary-layer model (parabolic) is used; and (3) recirculating flow modeled by the incompressible Navier-Stokes equations (elliptic). For matching of the numerical solutions in the three layers, two interaction models are developed: one for pressure interaction, the other for interaction between the shear layer and the recirculating flow. The uniform solution for the whole flowfield is then obtained by iteration of the local solutions under the constraints imposed by matching. The three-layer interactive model is used for solution of the flowfield past an asymmetric cavity. The method is shown to be capable of dealing with backflow without encountering problems at separation, characteristic to the boundary-layer approach. (Author)

A81-16581 * Shipboard trials of the Quiet Short-Haul Research Aircraft /QSRA/. J. L. Martin (NASA, Ames Research Center, Moffett Field, Calif.) and P. B. Strickland (U.S. Navy, Naval Air Test Center, Patuxent River, Md.). (*Society of Experimental Test Pilots, Symposium, 24th, Beverly Hills, Calif., Sept. 24-27, 1980.*) *Society of Experimental Test Pilots, Technical Review*, vol. 15, no. 2, 1980, p. 59-74, 6 refs.

The feasibility of the application of advanced state-of-the-art high lift STOL aircraft in the aircraft carrier environment was evaluated using the NASA Quiet Short-Haul Research Aircraft (QSRA). The QSRA made repeated unarrested landings and free deck takeoffs from the USS Kitty Hawk while being flown by three pilots of significant different backgrounds. The exercise demonstrated that the USB propulsive lift technology presents no unusual problems in the aircraft carrier environment. Optimum parameters for landing the QSRA were determined from the shore-based program; these proved satisfactory during operations aboard ship. Correlation of shipboard experience with shore-based data indicates that both free deck takeoffs and unarrested landings could be conducted with zero to 35 knots of wind across the deck of an aircraft carrier the size of the USS Kitty Hawk. B.J.

A81-16588 * The XV-15 tilt rotor research aircraft. D. C. Dugan (NASA, Ames Research Center, Moffett Field, Calif.), R. G. Erhart (Bell Helicopter Textron, Fort Worth, Tex.), and L. G. Schroers (U.S. Army, Aeromechanics Laboratory, Moffett Field, Calif.). (*Society of Experimental Test Pilots, Symposium, 24th, Beverly Hills, Calif., Sept. 24-27, 1980.*) *Society of Experimental Test Pilots, Technical Review*, vol. 15, no. 2, 1980, p. 168-185.

The XV-15 tilt rotor has shown good handling qualities in all modes of flight; in the helicopter mode it allows precision hover and agility with low pilot workload. Vibration and noise levels are low; the conversion procedure is easy, with satisfactory acceleration or deceleration. The XV-15 handling demonstrated its potential for many civil and military applications. A.T.

A81-17318 * Vecteded injection into compressible laminar and turbulent boundary layers. D. Degani (NASA, Ames Research Center, Moffett Field, Calif.; Technion - Israel Institute of Technology, Haifa, Israel), M. Y. Hussaini, and A. A. Wray (NASA, Ames Research Center, Moffett Field, Calif.). *Computer Methods in Applied Mechanics and Engineering*, vol. 25, Jan. 1981, p. 11-20, 14 refs.

A fundamental analysis of two-dimensional supersonic boundary layer flow, both laminar and turbulent, is presented for a wide range of normal and nonnormal mass-transfer velocities. The analysis is based on the numerical solution of the Navier-Stokes equations, and results are compared with available theoretical and experimental data. Certain cases of practical importance, for which results are not presently available, are referred to. (Author)

A81-23960 * Organized motion in turbulent flow. B. J. Cantwell (Stanford University, Stanford, Calif.). In: *Annual review of fluid mechanics*, Volume 13. (A81-23951 09-34) Palo Alto, Calif., Annual Reviews, Inc., 1981, p. 457-515, 137 refs. Grant No. NSG-2392.

A review of organized motion in turbulent flow indicates that the transport properties of most shear flows are dominated by large-scale vortex nonrandom motions. The mean velocity profile of a turbulent boundary layer consists of a viscous sublayer, buffer layer, and a logarithmic outer layer; an empirical formula of Coles (1956) applies to various pressure gradients. The boundary layer coherent structure was isolated by the correlation methods of Townsend (1956) and flow visualization by direct observations of complex unsteady turbulent motions. The near-wall studies of Willmarth and Wooldridge (1962) used the space-time correlation for pressure fluctuations at the wall under a thick turbulent boundary layer; finally, organized motion in free shear flows and transition-control of mixing demonstrated that the Reynolds number invariance of turbulence shows wide scatter. A.T.

A81-28686 * Transition in the axisymmetric jet. B. J. Cantwell (Stanford University, Stanford, Calif.). *Journal of Fluid Mechanics*, vol. 104, Mar. 1981, p. 369-386, 18 refs. Grant No. NSG-2392.

Unsteady particle trajectories are used to study structural features associated with the Reynolds-number dependence of an axisymmetric jet. It is found that transition in the unbounded jet is in the nature of transition in Couette flow and occurs at specific critical values of the Reynolds number rather than in some range over which small disturbances are amplified. In the case of the creeping-flow solution, the particle-path pattern exhibits a structure which is not easily discerned in any of the other variables that govern the flow. For sufficiently small Reynolds number, the particle paths converge to a single stable node which lies on the axis of the jet. At a Reynolds number of 6.7806, the pattern bifurcates to a saddle and two stable nodes; at a Reynolds number of 10.09089, it bifurcates a second time to form a saddle and two stable foci. V.L.

A81-37234 * Interactive method for computation of viscous flow with recirculation. J. Brandeis (NASA, Ames Research Center, Moffett Field, Calif.) and J. Rom (Technion - Israel Institute of Technology, Haifa, Israel). *Journal of Computational Physics*, vol. 40, Apr. 1981, p. 396-410, 11 refs.

An interactive method is proposed for the solution of two-dimensional, laminar flow fields with identifiable regions of recirculation, such as the shear-layer-driven cavity flow. The method treats the flow field as composed of two regions, with an appropriate mathematical model adopted for each region. The shear layer is computed by the compressible boundary layer equations, and the slowly recirculating flow by the incompressible Navier-Stokes equations. The flow field is solved iteratively by matching the local solutions in the two regions. For this purpose a new matching method utilizing an overlap between the two computational regions is developed, and shown to be most satisfactory. Matching of the two velocity components, as well as the change in velocity with respect to depth is amply accomplished using the present approach, and the stagnation points corresponding to separation and reattachment of the dividing streamline are computed as part of the interactive solution. The interactive method is applied to the test problem of a shear layer driven cavity. The computational results are used to show the validity and applicability of the present approach. (Author)

A81-41090 * # Transonic swept wings studied by the lifting-line theory. H. K. Cheng, S. Y. Meng (Southern California University, Los Angeles, CA), R. Chow (Grumman Aerospace Corp., Bethpage, NY), and R. C. Smith (NASA, Ames Research Center,

Aeronautics Div., Moffett Field, CA). *AIAA Journal*, vol. 19, Aug. 1981, p. 961-968. 46 refs. Contract No. N00014-75-C-0520; Grants No. NCR-530-501; No. NCA2-OR-730-601.

Transonic swept wings are analyzed as a lifting-line problem under a small-disturbance approximation. Basic concepts and principal results of the asymptotic theory are discussed. The study focuses on straight oblique wings and V-shaped swept wings, of which the local centerline curvature can be equated to zero. The three-dimensional (3-D) perturbation of the nonlinear component flow admits a similarity flow structure but requires that all wing sections are generated from a single airfoil profile; the reduced 2-D problems in this case are solved only once for all span stations. Examples of solutions involving high subcritical and slightly supercritical component flows are demonstrated and compared with surface pressure data from 3-D computer codes based on the full-potential equation (FLO 22). Except in the neighborhood of leading edges, where the small-disturbance assumption breaks down, and in the vicinities of wing tips and the symmetry plane, where neither the theory nor the 3-D codes may claim full validity, reasonable agreement is consistently found. The explicit results from the upwash analysis, along with the similarity flow structure, provides a rational approach to the control of 3-D effects in transonic aerodynamic design studies. (Author)

A81-44444 * # A compatibility assessment method for adaptive-wall wind tunnels. S. S. Davis (NASA, Ames Research Center, Moffett Field, CA). *AIAA Journal*, vol. 19, Sept. 1981, p. 1169-1173. 22 refs.

A new method is described for assessing the compatibility between inner and outer flow regimes in adaptive-wall wind tunnels. The method is applicable to both two- and three-dimensional flows, and unlike other schemes, requires the measurement of only one velocity component. Moreover, a complete solution to the outer flowfield is not required with the new method. Computer simulations of two- and three-dimensional flows are presented along with data from a two-dimensional pilot wind tunnel test using the new method. (Author)

CONFERENCE AND MEETING PAPERS

N81-19012*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

OVERVIEW OF ADVANCED WING DESIGN c05

Raymond M. Hicks /In NASA. Langley Research Center Advan. Aerodyn. and Active Controls Feb. 1981 p 157-169 ref (For primary document see N81-19001 10-01)

Avail: NTIS HC A09/MF A01 CSCL 01C

Examples of experiment theory correlation are presented to give an indication of the capabilities and limitations of wing design and analysis for transonic applications by potential flow theory. The examples include correlations of experimental pressure distributions with theoretical results from isolated wing codes and wing-body codes. Both conservative and non conservative differencing as well as body and boundary layer corrections are considered. A full potential isolated wing code correlates well with data from an isolated wing test but may give poor prediction of the aerodynamic characteristics of some wing-body configurations. Potential flow wing body codes were found to improve the correlation for the wing-body configurations considered. E.D.K.

N81-19013*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ADVANCED TURBOPROP INSTALLATION AERODYNAMICS c07

R. C. Smith /In NASA. Langley Research Center Advan. Aerodyn. and Active Controls Feb. 1981 p 171-181 refs (For primary document see N81-19001 10-01)

Avail: NTIS HC A09/MF A01 CSCL 21E

The expected aerodynamic effects of a propfan installed on a thick supercritical wing are summarized qualitatively. Nacelle/wing and jet interactions, slipstream incremental velocity, nonuniform inflow, and swirl loss recovery are discussed. E.D.K.

A81-20598 * # Unsteady fan blade pressure and acoustic radiation from a JT15D-1 turbofan engine at simulated forward speed. J. S. Preisser, J. A. Schoenster, R. A. Golub (NASA, Langley Research Center, Hampton, Va.), and C. Horne (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0096*. 13 p. 12 refs.

Tests have been conducted on a JT15D-1 turbofan engine both statically and at simulated forward speed in the Ames 12 x 24 Meter Wind Tunnel. Both far-field acoustic data and unsteady pressure data from transducers mounted on the fan blades were acquired. Results showed a sound power reduction of about 10 dB in the far-field acoustic levels with simulated forward speed over those measured without forward speed. Blade mounted transducer results showed rotor-turbulence interaction dominated the noise field at very low speeds while an interaction between the rotor and internal struts dominated at higher speeds. Results are presented to show the effects of varying engine rpm, changing the angle-of-attack of the engine inlet to tunnel flow and mounting an aircraft wing to simulate an installation condition on an actual aircraft. (Author)

N81-31107*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

IMPACT OF HIGH-ALPHA AERODYNAMICS ON DYNAMIC STABILITY PARAMETERS OF AIRCRAFT AND MISSILES c02

Gerald N. Malcolm /In AGARD Dyn. Stability Parameters May 1981 18 p refs (For primary document see N81-31105 22-01)

Avail: NTIS HC A17/MF A01 CSCL 01A

The aerodynamic phenomena associated with high angles of attack and their effects on the dynamic stability characteristics of airplane and missile configurations are examined. Information on dynamic effects is limited. Steady flow phenomena and their effects on the forces and moments are reviewed. The effects of asymmetric vortices and of vortex bursting on the dynamic response of flight vehicles are reviewed with respect to their influence on: (1) nonlinearity of aerodynamic coefficients with attitude, rates, and accelerations; (2) cross coupling between longitudinal and lateral directional models of motion; (3) time dependence and hysteresis effects; (4) configuration dependency; and (5) mathematical modeling of the aerodynamics. Author

N81-31111*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ROTARY AND MAGNUS BALANCES c09

Gerald N. Malcolm /In AGARD Dyn. Stability Parameters May 1981 26 p refs (For primary document see N81-31105 22-01)

Avail: NTIS HC A17/MF A01 CSCL 01A

Two wind tunnel techniques for determining part of the aerodynamic information required to describe the dynamic behavior of various types of vehicles in flight are described. Force and moment measurements are determined with a rotary-balance apparatus in a coning motion and with a Magnus balance in a high-speed spinning motion. Coning motion is pertinent to both aircraft and missiles, and spinning is important for spin stabilized missiles. Basic principles of both techniques are described, and specific examples of each type of apparatus are presented. Typical experimental results are also discussed. Author

A81-34191 * Preliminary aerodynamic characteristics of several advanced VSTOL fighter/attack aircraft concepts. W. P. Nelms and D. A. Durston (NASA, Ames Research Center, Moffett Field, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801178*. 23 p. 14 refs. NASA-Navy-sponsored research.

VSTOL attack aircraft to be developed in the mid- or late-1990's and research programs dealing with possible characteristics are discussed. Design studies of horizontal attitude takeoff and landing (HATOL) and vertical attitude takeoff and landing (VATOL) type aircraft were executed and wind tunnel models were built and tested. The configurations tested were a wing-canard HATOL concept with jet-diffuser ejectors as a vertical lift system and a variety of the same with nacelles which are closer together. Other proposals were a HATOL concept with wing-canard design and two vertical tails on twin afterbodies, and a VATOL concept which is tailless with an extended leading-edge wing to increase lift. Aerodynamic uncertainties were defined and wind tunnel tests were made. Special research concerning top-mounted air induction systems is also covered. D.B.

A81-34193 * AD-1 oblique wing aircraft program. W. H. Andrews, A. G. Sim, R. C. Monaghan, L. R. Felt, T. C. McMurty (NASA, Flight Research Center, Edwards AFB, Calif.), and R. C. Smith (NASA, Ames Research Center, Moffett Field, Calif.). *Society of Automotive Engineers, Aerospace Congress and Exposition, Los Angeles, Calif., Oct. 13-16, 1980, Paper 801180*. 9 p. 7 refs.

The oblique wing concept for super- and subsonic transport was assessed by analysis and wind tunnel radio control model and remotely piloted vehicle testing. A one-sixth scale wind tunnel model and a low speed manned oblique wing research airplane (AD-1) were developed. Model wind tunnel test data on dynamic structural response characteristics were used in a simulator to develop the control system. The airplane is of simple design with fiber glass skin, weight of approximately 2100 lbs and speeds of up to 175 knots at altitudes up to 15,000 ft. Flight testing will investigate handling and flying qualities, oblique wing flight control characteristics, aeroelastic wing design and will compare actual with predicted aerodynamic characteristics. Nineteen flights were made at 12,000 to 13,000 feet with speeds of 100-160 knots. Flutter clearance as a function of wing sweep angle is now under investigation. D.B.

A81-38102 * # PAN AIR - A higher order panel method for predicting subsonic or supersonic linear potential flows about arbitrary configurations. R. L. Carmichael and L. L. Erickson (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1255*. 35 p. 45 refs.

PAN AIR is a computer program for predicting subsonic or supersonic linear potential flow about arbitrary configurations. It uses linear source and quadratic doublet strength distributions. These higher-order distributions have been implemented in a manner that greatly reduces the numerical stability problems that have plagued earlier attempts to make surface paneling methods work successfully for supersonic flow. PAN AIR's problem-solving capability, numerical approach, modeling features, and program architecture are described. Numerical results are presented for a variety of geometries at supersonic Mach numbers. (Author)

A81-39004 * # Computation of simple three-dimensional wing-vortex interaction in transonic flow. G. R. Srinivasan (Flow Simulations, Inc., Sunnyvale, CA), W. J. Chyu (NASA, Ames Research Center, Moffett Field, CA), and J. L. Steger (Stanford University, Stanford, CA). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1206*. 12 p. 17 refs.

An implicit delta form finite-difference algorithm for Euler equations in conservation law form has been used in preliminary calculations of three-dimensional wing-vortex interactions. Both steady and unsteady transonic flow wing-vortex interactions are computed. The computations themselves are meant to guide upcoming wind tunnel experiments of the same flow field. Various modifications to the numerical method that are intended to improve computational efficiency are also described and tested in both two- and three-dimensions. (Author)

A81-39011 * # Flow separation in shear-layer-driven cavities. J. Brandeis (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1247*. 13 p. 15 refs.

A study of the shear-layer flow over a range of open-top cavity configurations is reported. Emphasis is placed on the effect that altering the cavity's span length and aspect ratio has on the development of the shear layer. Computational results are obtained using an interactive method which adapts the compressible boundary-layer model for the flow above the cavity and incompressible Navier-Stokes equations within the enclosure. Interaction of this composite model with the outer, inviscid supersonic flow is also considered in one case. The results show that the location of the stagnation points is sensitive primarily to the variation of the span. When the span was fixed and the aspect ratio varied, the shear layer was nearly unaffected except at aspect ratios less than 0.5. Interaction with the outer flow had a smoothing effect on the shape of the dividing streamline but did not significantly affect the location of the stagnation points. (Author)

A81-40137 * # Computerized three-dimensional aerodynamic design of a lifting rotor blade. M. E. Tauber and R. M. Hicks (NASA, Ames Research Center, Moffett Field, CA). In: *American Helicopter Society, Annual Forum, 36th, Washington, DC, May 13-15, 1980, Proceedings. (A81-40136 18-01)* Washington, DC, American Helicopter Society, 1980. 12 p. 12 refs. (AHS 80-2)

A three-dimensional, inviscid, full-potential lifting rotor code was used to demonstrate that pressure distributions on both advancing and retreating blades could be significantly improved by perturbing local airfoil sections. The perturbations were described by simple geometric shape functions. To illustrate the procedure, an example calculation was made at a forward flight speed of 85 m/sec (165 knots) and an advance ratio of 0.385. It was found that a minimum of three shape functions was required to improve the pressures without producing undesirable secondary effects in high-speed forward flight on a hypothetical modern rotor blade initially having an NLR-1 supercritical airfoil. Reductions in the shock strength on the advancing blade could be achieved, while simultaneously lessening leading-edge pressure gradients on the retreating blade. The major blade section modifications required were blunting of the upper surface leading edge and some reshaping of the blade's upper surface resulting in moderately thicker airfoils. (Author)

A81-42730 * Transonic wing design using potential-flow codes - Successes and failures. R. M. Hicks (NASA, Ames Research Center, Moffett Field, CA). *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 7-10, 1981, Paper 810565*. 34 p. 28 refs.

The state-of-the-art of transonic wing design by use of computer codes based on the potential flow-theory is presented. The capabilities and limitations of these codes are exemplified by several experiment-theory correlations, including an assessment of pressure distribution from isolated wing and wing-body codes. Computer codes using both conservative and nonconservative differencing schemes were used, and the effects of boundary-layer corrections were considered. Results showed that calculations from a full

potential, isolated code correlate well with data from an isolated wing test, but may give poor predictions of the aerodynamic characteristics of some wing-body configurations. Boundary-layer correlations were found to have only moderate effects on experiment-theory correlation. Aeroelastic effects were considered important for high aspect ratio wings of low to moderate thickness, and viscous effects were minimal for typical cruise conditions, even for Reynold's numbers as low as two million. The effect of wind-tunnel walls on experiment-theory correlations remained inconclusive. A wing-body code was used to calculate the flow field about a wing-body configuration with body-mounted engines, typical of the transonic Biz-Jet aircraft. J.F.

A81-43946 * # Lift-enhancing surfaces on several advanced V/STOL fighter/attack aircraft concepts. D. A. Durston and S. C. Smith (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1675*. 17 p. 16 refs.

An analysis of the relative influences of forward lift-enhancing surfaces on the overall lift and drag characteristics of three wind-tunnel models representative of V/STOL fighter/attack aircraft is presented. Two of the models are canard-wing configurations and one has a wing leading-edge extension (LEX) as the forward lifting surface. Data are taken from wind-tunnel tests of each model covering Mach numbers from 0.4 to 1.4. Overall lift and drag characteristics of these models and the generally favorable interactions of the forward surfaces with the wings are highlighted. Results indicate that larger LEX's and canards generally give greater lift and drag improvements than ones that are smaller relative to the wings. (Author)

A81-45890 * # Measurements of the boundary layer and near wake of a supercritical airfoil at cruise conditions. D. A. Johnson (NASA, Ames Research Center, Moffett Field, CA) and F. W. Spaid (McDonnell Douglas Research Laboratories, St. Louis, MO). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1242*. 15 p. 10 refs.

The flow behavior within the upper-surface boundary layer and near wake of a supercritical airfoil operating at cruise conditions is discussed. Experimental results obtained from wind-tunnel tests are presented which provide a more detailed description of the flow in these regions than was previously available. Mean streamwise velocity profiles measured by pitot-pressure-probe and laser-velocimeter techniques were found to be in excellent agreement. Other mean-flow properties obtained by the laser-velocimeter technique were the local flow angles in the viscous layers and the static pressures at the edges of the boundary layer and wake. The data set also includes measurements of the turbulence intensity and turbulent Reynolds-stress distributions as obtained by the laser-velocimeter technique. To assess the effects of the shock wave, a less extensive set of measurements was realized at a subcritical test condition. The two test conditions (Mach number at free-stream conditions = 0.72, airfoil section lift coefficient = 0.76 and Mach number of free-stream conditions = 0.5, airfoil section lift coefficient = 0.75) provide a good test for state-of-the-art prediction methods because the upper-surface-boundary layer is separated just upstream of the trailing edge in both cases. (Author)

F

AIRCRAFT OPERATIONS DIVISION

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-22122 * Long-wave stratospheric transmission of Mount St. Helens ejecta. P. M. Kuhn (Raven Systems and Research, Inc., Boulder, Colo.), L. C. Haughney, and R. C. Innis (NASA, Ames Research Center, Moffett Field, Calif.). *Optics Letters*, vol. 6, Jan. 1981, p. 24-26. 6 refs. NASA-supported research.

The NASA/Ames Research C-141 aircraft underflew the Mount St. Helens ejecta plume in Utah three days after the eruption. Upward-looking 20-40-microns on-board radiometry provided data resulting in a calculated long-wave transmission of 0.93. From this value, an optical depth of 0.073 is inferred. This value is compared with an accepted background, stratospheric infrared optical depth of 0.06. Assumptions on particle size, shortwave albedo, and thermal warming imply little surface temperature change caused by the ejecta on the third day immediately following the eruption. (Author)

CONFERENCE AND MEETING PAPERS

A81-40120 * A pilot's assessment of helicopter handling-quality factors common to both agility and instrument flying tasks. R. M. Gerdes (NASA, Ames Research Center, Moffett Field, CA). In: *European Rotorcraft and Powered Lift Aircraft Forum, 6th, Bristol, England, September 16-19, 1980, Conference Papers. Part 2*. (A81-40076 18-01) Bristol, University of Bristol, 1980. 18 p. 7 refs.

Results from a series of simulation and flight investigations undertaken to evaluate helicopter flying qualities and the effects of control system augmentation for nap-of-the-earth (NOE) agility and instrument flying tasks were analyzed to assess handling-quality factors common to both tasks. Precise attitude control was determined to be a key requirement for successful accomplishment of both tasks. Factors that degraded attitude controllability were improper levels of control sensitivity and damping and rotor-system cross-coupling due to helicopter angular rate and collective pitch input. Application of rate-command, attitude-command, and control-input decouple augmentation schemes enhanced attitude control and significantly improved handling qualities for both tasks. NOE agility and instrument flying handling-quality considerations, pilot rating philosophy, and supplemental flight evaluations are also discussed. (Author)

FLIGHT SYSTEMS AND SIMULATION RESEARCH DIVISION

NASA FORMAL REPORTS

N81-16040*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SAMPLE DATA EFFECTS OF HIGH-PASS FILTERS

David O. Chin Jan. 1981 32 p refs
(NASA-TP-1797; A-8361) Avail: NTIS HC A03/MF A01 CSCL 01C

Four mathematical models of linear first and second order high pass washout filters were analyzed. These models were Euler's Integration, Zero-Order Hold, Bilinear Transformation, and Second-Order Adams-Bashforth Integration. Bode responses for each model at various sample rates were compared to the continuous filter response. Higher sample rates produced Bode responses approaching the continuous response and the Bilinear Transformation model produced the best responses over the frequency spectrum and sample rates. Pole location analysis of each model in the z-plane showed the Bilinear Transformation and Zero-Order Hold models gave stable poles regardless of time step size, whereas the other models did not display stable poles. A near constant gain error over the entire frequency spectrum was discovered in the Zero-Order Hold cases and a correction gain was calculated for the first-order high-pass filter case.

S.F.

N81-19131*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLIGHT-TEST EVALUATION OF STOL CONTROL AND FLIGHT DIRECTOR CONCEPTS IN A POWERED-LIFT AIRCRAFT FLYING CURVED DECELERATING APPROACHES

W. S. Hindson (National Research Council of Canada, Ottawa, Ontario), G. H. Hardy, and R. C. Innis Mar. 1981 96 p refs
(NASA-TP-1641; A-8190) Avail: NTIS HC A05/MF A01 CSCL 01C

Flight tests were carried out to assess the feasibility of piloted steep curved, and decelerating approach profiles in powered lift STOL aircraft. Several STOL control concepts representative of a variety of aircraft were evaluated in conjunction with suitably designed flight directions. The tests were carried out in a real navigation environment, employed special electronic cockpit displays, and included the development of the performance achieved and the control utilization involved in flying 180 deg turning, descending, and decelerating approach profiles to landing. The results suggest that such moderately complex piloted instrument approaches may indeed be feasible from a pilot acceptance point of view, given an acceptable navigation environment. Systems with the capability of those used in this experiment can provide the potential of achieving instrument operations on curved, descending, and decelerating landing approaches to weather minima corresponding to CTOL Category 2 criteria, while also providing a means of realizing more efficient operations during visual flight conditions.

Author

N81-22039*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

KINEMATIC PROPERTIES OF THE HELICOPTER IN COORDINATED TURNS

Robert T. N. Chen and James A. Jeske Apr. 1981 41 p refs
(NASA-TP-1773; A-8399) Avail: NTIS HC A03/MF A01 CSCL 01C

A study on the kinematic relationship of the variables of helicopter motion in steady, coordinated turns involving inherent sideslip is described. A set of exact kinematic equations which govern a steady coordinated helical turn about an Earth referenced vertical axis is developed. A precise definition for the load factor parameter that best characterizes a coordinated turn is proposed. Formulas are developed which relate the aircraft angular rates

and pitch and roll attitudes to the turn parameters, angle of attack, and inherent sideslip. A steep, coordinated helical turn at extreme angles of attack with inherent sideslip is of primary interest. The bank angle of the aircraft can differ markedly from the tilt angle of the normal load factor. The normal load factor can also differ substantially from the accelerometer reading along the vertical body axis of the aircraft. Sideslip has a strong influence on the pitch attitude and roll rate of the helicopter. Pitch rate is independent of angle of attack in a coordinated turn and in the absence of sideslip, angular rates about the stability axes are independent of the aerodynamic characteristics of the aircraft.

S.F.

NASA TECHNICAL MEMORANDA

X81-10006*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ANALYSIS OF CONTROL ACTUATOR AUTHORITY REQUIREMENTS FOR ATTITUDE AND TRANSLATIONAL RATE COMMAND AUGMENTATION SYSTEMS FOR THE XV-15 TILT ROTOR RESEARCH AIRCRAFT

William L. Brigadier Dec. 1980 147 p refs
(NASA-TM-81243; A-8358; AVRADCOM-TR-80-A-13)

Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

The methodology consists of applications of linear analysis and piloted simulation to determine actuator authority requirements. Aircraft characteristic modes were obtained from linear aircraft state equations and then approximated by resulting dominant modes. Dominant mode analysis was used to determine dynamic interaction on SCAS amplitude and phase of varying feedforward and feedback gains. Experimental data are presented for evaluation of the methodology for tasks and SCAS types which are likely candidates for future tilt rotor operation. Tasks include STOL approach to landing, terrain following, nap-of-the-Earth, accelerations and decelerations and gunnery runs. SCAS types include rate command, rate command/attitude hold, attitude command and translational rate command. Parameters of each SCAS type were varied to assess the effect on SCAS authority requirements. SCAS authorities were limited in all SCAS channels in a systematic fashion to determine the influence on task performance for each SCAS type. Pilot ratings were obtained to determine the implications for mission effectiveness and handling qualities degradation of limiting SCAS authority. A failure modes analysis was performed to ascertain the risk to pilot and aircraft given increased SCAS authority in the event of computer-commanded SCAS actuator handover.

T.M.

N81-10077*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A PILOTED SIMULATOR INVESTIGATION OF STATIC STABILITY AND STABILITY/CONTROL AUGMENTATION EFFECTS ON HELICOPTER HANDLING QUALITIES FOR INSTRUMENT APPROACH

J. V. Lebacqz, R. D. Forrest, and R. M. Gerdes Sep. 1980 393 p refs
(NASA-TM-81188; FAA-RD-8064; A-8125) Avail: NTIS HC A17/MF A01 CSCL 01C

A motion base simulator was used to compare the flying qualities of three generic single rotor helicopters during a full attention to flight control task. Terminal area instrument approaches were flown with and without turbulence. The turbulence of helicopter static stability was investigated in terms of the values of cockpit control gradients as specified in the

existing airworthiness criteria. The effectiveness of several types of stability control augmentation systems in improving the instrument flight rules capability of helicopters with reduced static stability was examined. Two levels of static stability in the pitch, roll, and yaw axes were examined for a hingeless rotor configuration; the variations were stable and neutral static stability in pitch and roll, and two levels of stability in yaw. For the lower level of static stability, four types of stability and control augmentation were examined for helicopters with three rotor types: hingeless, articulated, and teetering. S.F.

N81-11043* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATING STUDY OF THE INTERACTION BETWEEN THE PROPULSION AND FLIGHT CONTROL SYSTEMS OF A SUBSONIC LIFT FAN VTOL

Bruce E. Tinling and Gary L. Cole Nov. 1980 50 p refs (NASA-TM-81239; A-8346) Avail: NTIS HC A03/MF A01 CSDL 01C

The possibility of interactions between the propulsion and flight control systems of a three-fan subsonic VTOL aircraft was studied using nonreal time simulation. Time histories of critical internal engine parameters were obtained and possible deleterious effects of engine dynamics on flight control were identified and analyzed. No deleterious effects, with the exception of the effects of the fan actuator deadband, were found. A method of alleviating these effects through feedback of the actuator output to the flight controller was developed. T.M.

N81-12065* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A MATHEMATICAL MODEL OF THE CH-53 HELICOPTER

William R. Sturgeon and James D. Phillips Nov. 1980 60 p refs (NASA-TM-81238; A-8345) Avail: NTIS HC A04/MF A01 CSDL 01C

A mathematical model suitable for real time simulation of the CH-53 helicopter is presented. This model, which is based on modified nonlinear classical rotor theory and nonlinear fuselage aerodynamics, will be used to support terminal-area guidance and navigation studies on a fixed-base simulator. Validation is achieved by comparing the model response with that of a similar aircraft and by a qualitative comparison of the handling characteristics made by experienced pilots. Author

N81-13673* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

GLOBAL OPTIMALITY OF EXTREMALS: AN EXAMPLE

Eliezer Kreindler (Technion, Israel Inst. of Technology, Haifa) and Frank Newman Oct. 1980 23 p refs (NASA-TM-81240; A-8347) Avail: NTIS HC A02/MF A01 CSDL 12A

The question of the existence and location of Darboux points is crucial for minimally sufficient conditions for global optimality and for computation of optimal trajectories. A numerical investigation is presented of the Darboux points and their relationship with conjugate points for a problem of minimum fuel, constant velocity, and horizontal aircraft turns to capture a line. This simple second order optimal control problem shows that ignoring the possible existence of Darboux points may play havoc with the computation of optimal trajectories. E.D.K.

N81-19014* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLIGHT INVESTIGATION OF A FOUR-DIMENSIONAL TERMINAL AREA GUIDANCE SYSTEM FOR STOL AIRCRAFT

Frank Neuman and Gordon Hardy Mar. 1981 43 p refs (NASA-TM-81271; A-8491) Avail: NTIS HC A03/MF A01 CSDL 17G

A series of flight tests and fast-time simulations were conducted, using the augmentor wing jet STOL research aircraft and the STOLAND 4D-RNAV system to add to the growing data base of 4D-RNAV system performance capabilities. To obtain statistically meaningful data a limited amount of flight data were supplemented by a statistically significant amount of data obtained from fast-time simulation. The results of these tests are reported. Included are comparisons of the 4D-RNAV estimated winds with actual winds encountered in flight, as well as data on along-track navigation and guidance errors, and time-of-arrival errors at the final approach waypoint. In addition, a slight improvement of the STOLAND 4D-RNAV system is proposed and demonstrated, using the fast-time simulation. T.M.

N81-19100* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HISTORICAL OVERVIEW OF V/STOL AIRCRAFT TECHNOLOGY

Seth B. Anderson Mar. 1981 16 p (NASA-TM-81280; A-8511) Avail: NTIS HC A02/MF A01 CSDL 01C

The requirements for satisfactory characteristics in several key technology areas are discussed and a review is made of various V/STOL aircraft for the purpose of assessing the success or failure of each design in meeting design requirements. Special operating techniques were developed to help circumvent deficiencies. For the most part performance and handling qualities limitations restricted operational evaluations. Flight operations emphasized the need for good STOL performance, good handling qualities, and stability and control augmentation. The majority of aircraft suffered adverse ground effects. T.M.

N81-20006* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DESIGN OF A FUEL-EFFICIENT GUIDANCE SYSTEM FOR A STOL AIRCRAFT

John D. McLean and Heinz Erzberger Mar. 1981 65 p refs (NASA-TM-81256; A-8427) Avail: NTIS HC A04/MF A01 CSDL 01A

In the predictive mode, the system synthesizes a horizontal path from an initial aircraft position and heading to a desired final position and heading and then synthesizes a fuel-efficient speed-altitude profile along the path. In the track mode, the synthesized trajectory is reconstructed and tracked automatically. An analytical basis for the design of the system is presented and a description of the airborne computer implementation is given. A detailed discussion of the software, which should be helpful to those who use the actual software developed for these tests, is also provided. T.M.

N81-20030* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN EXTENSION OF THE LOCAL MOMENTUM THEORY TO A DISTORTED WAKE MODEL OF A HOVERING ROTOR

Keiji Kawachi Feb. 1981 112 p refs (NASA-TM-81258; A-8438) Avail: NTIS HC A06/MF A01 CSDL 01A

The local momentum theory is based on the instantaneous balance between the fluid momentum and the blade elemental lift at a local station in the rotor rotational plane. Therefore, the theory has the capability of evaluating time wise variations of air loading and induced velocity distributions along a helicopter blade span. Unlike a complex vortex theory, this theory was developed to analyze the instantaneous induced velocity distribution effectively. The boundaries of this theory and a computer program using this theory are discussed. A concept introduced into the theory is the effect of the rotor wake contraction in

hovering flight. A comparison of this extended local momentum theory with a prescribed wake vortex theory is also presented. The results indicate that the extended local momentum theory has the capability of achieving a level of accuracy similar to that of the prescribed wake vortex theory over wide range variations of rotor geometrical parameters. It is also shown that the analytical results obtained using either theory are in reasonable agreement with experimental data. E.D.K.

N81-21831* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A SOLUTION FOR TWO-DIMENSIONAL FREDHOLM INTEGRAL EQUATIONS OF THE SECOND KIND WITH PERIODIC, SEMIPERIODIC, OR NONPERIODIC KERNELS
Ralph E. Gabrielsen and Aynur Uenal (Stanford Univ., Calif.) Apr. 1981 31 p refs Prepared in cooperation with Army Aviation Research and Development Command, Moffett Field, Calif. (NASA-TM-81249; A-8410; USAVRADCOM-TR-81-A-4) Avail: NTIS HC A03/MF A01 CSCL 12A

A numerical scheme for solving two dimensional Fredholm integral equations of the second kind is developed. The proof of the convergence of the numerical scheme is shown for three cases: the case of periodic kernels, the case of semiperiodic kernels, and the case of nonperiodic kernels. Applications to the incompressible, stationary Navier-Stokes problem are of primary interest. M.G.

N81-24391* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

REDUCTION OF THE TWO DIMENSIONAL STATIONARY NAVIER-STOKES PROBLEM TO A SEQUENCE OF FREDHOLM INTEGRAL EQUATIONS OF THE SECOND KIND
Ralph E. Gabrielsen Apr. 1981 12 p refs Prepared in cooperation with Army Aviation Research and Development Command (NASA-TM-81272; A-8494; USAVRADCOM-TR-81-A-10) Avail: NTIS HC A02/MF A01 CSCL 20D

Present approaches to solving the stationary Navier-Stokes equations are of limited value; however, there does exist an equivalent representation of the problem that has significant potential in solving such problems. This is due to the fact that the equivalent representation consists of a sequence of Fredholm integral equations of the second kind, and the solving of this type of problem is very well developed. For the problem in this form, there is an excellent chance to also determine explicit error estimates, since bounded, rather than unbounded, linear operators are dealt with. A.R.H.

N81-27061* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ATC SIMULATION OF HELICOPTER IFR APPROACHES INTO MAJOR TERMINAL AREAS USING RNAV, MLS, AND CDTI

L. Tobias, H. Q. Lee, L. L. Peach, F. M. Willett, Jr. (FAA, Atlantic City), and P. J. OBrien (FAA, Atlantic City) Apr. 1981 55 p refs (NASA-TM-81301; A-8606) Avail: NTIS HC A04/MF A01 CSCL 01C

The introduction of independent helicopter IFR routes at hub airports was investigated in a real time air traffic control system simulation involving a piloted helicopter simulator, computer generated air traffic, and air traffic controllers. The helicopter simulator was equipped to fly area navigation (RNAV) routes and microwave landing system approaches. Problems studied included: (1) pilot acceptance of the approach procedure and tracking accuracy; (2) ATC procedures for handling a mix of helicopter and fixed wing traffic; and (3) utility of the cockpit display of traffic information (CDTI) for the helicopter in the hub airport environment. Results indicate that the helicopter routes were acceptable to the subject pilots and were noninterfering with fixed wing traffic. Merging and spacing maneuvers using

CDTI were successfully carried out by the pilots, but controllers had some reservations concerning the acceptability of the CDTI procedures. Author

N81-29133* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MINIMUM FUEL HORIZONTAL FLIGHTPATHS IN THE TERMINAL AREA

Eliezer Kreindler (Technion - Israel Inst. of Tech.) and Frank Neuman Aug. 1981 40 p refs (NASA-TM-81313; A-8676) Avail: NTIS HC A03/MF A01 CSCL 17G

The problem of minimum fuel airplane trajectories from arbitrary initial states to be fixed final state is considered. There are four state variables (two position coordinates, heading, and constrained velocity) and two constrained controls (thrust and bank angle). The fuel optimality of circular and straight line flightpaths is examined. Representative extremals (trajectories satisfying the necessary conditions of the minimum principle) of various types are computed and used to evaluate trajectories generated by an on line algorithm. Attention is paid to the existence of Darboux points (beyond which an extremal ceases to be globally optimal). One fuel flow rate model includes a term quadratic in thrust; hence, the optimal thrust is continuous and nonsingular. The other fuel flow rate model is linear in thrust, and consequently the optimal thrust is discontinuous and singular. M.G.

N81-30080* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFLUENCE OF FRICTION FORCES ON THE MOTION OF VTOL AIRCRAFT DURING LANDING OPERATIONS ON SHIPS AT SEA

James C. Howard and David O. Chin Sep. 1981 40 p refs (NASA-TM-81305; A-8641) Avail: NTIS HC A03/MF A01 CSCL 01B

Equations describing the friction forces generated during landing operations on ships at sea were formulated. These forces depend on the platform reaction and the coefficient of friction. The platform reaction depends on the relative sink rate and the shock absorbing capability of the landing gear. The friction coefficient varies with the surface condition of the landing platform and the angle of yaw of the aircraft relative to the landing platform. Landings by VTOL aircraft, equipped with conventional oleopneumatic landing gears are discussed. Simplifications are introduced to reduce the complexity of the mathematical description of the tire and shock strut characteristics. Approximating the actual complicated force deflection characteristic of the tire by linear relationship is adequate. The internal friction forces in the shock strut are included in the landing gear model. A set of relatively simple equations was obtained by including only those tire and shock strut characteristics that contribute significantly to the generation of landing gear forces. A.R.H.

N81-30082* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPARISONS OF AEROX COMPUTER PROGRAM PREDICTIONS OF LIFT AND INDUCED DRAG WITH FLIGHT TEST DATA

John Axelson and Gary C. Hill Aug. 1981 78 p refs (NASA-TM-81237; A-8344) Avail: NTIS HC A05/MF A01 CSCL 01A

The AEROX aerodynamic computer program which provides accurate predictions of induced drag and trim drag for the full angle of attack range and for Mach numbers from 0.4 to 3.0 is described. This capability is demonstrated comparing flight test data and AEROX predictions for 17 different tactical aircraft. Values of minimum (skin friction, pressure, and zero lift wave) drag coefficients and lift coefficient offset due to camber (when required) were input from the flight test data to produce total lift and drag curves. The comparisons of trimmed lift drag polars show excellent agreement between the AEROX predictions and the in flight measurements. S.F.

N81-30136* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
**SIMULATION STUDY OF TWO VTOL CONTROL/DISPLAY
SYSTEMS IN IMC APPROACH AND LANDING**
Vernon K. Merrick Aug. 1981 90 p refs
(NASA-TM-81295; A-8592) Avail: NTIS HC A05/MF A01
CSCL 01C

Both systems had full attitude command; the more complex system (Type 1) also had translational velocity command. The systems were applied to existing models of a VTOL lift-fan transport and the AV-8A Harrier. Simulated landings were made on a model of a DD963 Spruance-class destroyer. It was concluded that acceptable transitions and vertical landings can be performed, using the Type 1 system, in free-air turbulence up to 2.5 m/sec and sea state 6 and, using the Type 2 system, in free-air turbulence up to 1.5 m/sec and sea state 4. T.M.

N81-31228* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
**A TIME LAG STUDY OF THE VERTICAL MOTION SIMULA-
TOR COMPUTER SYSTEM**
William B. Cleveland Aug. 1981 21 p refs
(NASA-TM-81306; A-8654) Avail: NTIS HC A02/MF A01
CSCL 14B

A study was performed to evaluate an experimental method to determine time lags in real-time computer systems as the one associated with the Vertical Motion Simulator at Ames Research Center. The approach was to use an ordinary frequency analyzer to measure the phase difference between inputs and outputs of the computer system. The various elements of the program and computational architecture were modeled. Various factors, such as computer frame time and input frequency, were varied so that they were representative of the operational use of the simulator facilities. Experimentally determined results were compared with predictions derived from the simulation models. The results indicate that the frequency analyzer can be readily used to evaluate time lags in systems of this type. Differences between predicted and measured phase values indicate that the hardware and software imparts a time lag of about 5 msec to this facility. Author

N81-32151* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
**FLIGHT EVALUATION OF THE STOL FLARE AND LANDING
DURING NIGHT OPERATIONS**
James A. Franklin, Robert C. Innis, and Gordon H. Hardy Aug.
1981 46 p refs
(NASA-TM-81312; A-8704) Avail: NTIS HC A03/MF A01
CSCL 01C

Simulated instrument approaches were made to Category 1 minimums followed by a visual landing on a 100 x 1700 ft STOL runway. Data were obtained for variations in the aircraft's flare response characteristics and control techniques and for different combinations of aircraft and runway lighting and a visual approach slope indication. With the complete aircraft and runway lighting and visual guidance no degradation in flying qualities or landing performance was observed compared to daylight operations. Elimination of the touchdown zone floodlights or the aircraft landing lights led to somewhat greater pilot workload; however, the landing could still be accomplished successfully. Loss of both touchdown zone and aircraft landing lights led to a high workload situation and only a marginally adequate to inadequate landing capability. T.M.

NASA CONTRACTOR REPORTS

X81-10209* Boeing Commercial Airplane Co., Seattle, Wash.
**LARGE-SCALE WIND TUNNEL INVESTIGATION OF QUIET
SHORT-HAUL RESEARCH AIRCRAFT (QSRA) FLIGHTPATH**

CONTROL CONCEPTS Final Report
E. W. Kruppa Sep. 1980 514 p refs
(Contract NAS2-9196)
(NASA-CR-152348; D340-10105)

Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

Wind tunnel data obtained from ARC 40 by 80 ft Test 515, are presented. The Quiet Short-Haul Research Aircraft (QSRA) was used to obtain six component force and moment data. The characteristics of the inboard and outboard spoilers, the double slotted trailing edge flaps and the ailerons were investigated at high, medium, and low C_j 's at approach USB setting. Six runs were used for additional cruise performance study. The Boeing QSRA performance math model was updated and used to generate trimmed maps of velocity versus flightpath angle for various configurations. E.A.K.

N81-11014* Boeing Vertol Co., Philadelphia, Pa.
**FULL SCALE WIND TUNNEL INVESTIGATION OF A
BEARINGLESS MAIN HELICOPTER ROTOR Final Report**
10 Oct. 1980 608 p refs
(Contract NAS2-10333)
(NASA-CR-152373; D210-11659-1) Avail: NTIS
HC A99/MF A01 CSCL 01A

A stability test program was conducted to determine the effects of airspeed, collective pitch, rotor speed and shaft angle on stability and loads at speeds beyond that attained in the BMR/BO-105 flight test program. Loads and performance data were gathered at forward speeds up to 165 knots. The effect of cyclic pitch perturbations on rotor response was investigated at simulated level flight conditions. Two configuration variations were tested for their effect on stability. One variable was the control system stiffness. An axially softer pitch link was installed in place of the standard BO-105 pitch link. The second variation was the addition of elastomeric damper strips to increase the structural damping. The BMR was stable at all conditions tested. At fixed collective pitch, shaft angle and rotor speed, damping generally increased between hover and 60 knots, remained relatively constant from 60 to 90 knots, then decreased above 90 knots. Analytical predictions are in good agreement with test data up to 90 knots, but the trend of decreasing damping above 90 knots is contrary to the theory. A.R.H.

N81-12054* American Electronic Labs., Inc., Lansdale, Pa.
**LOW COST AIRBORNE MICROWAVE LANDING SYSTEM
RECEIVER, TASK 3 Final Report**
James B. Hager and James R. VanCleave Dec. 1979 191 p
(Contract NAS2-9332)
(NASA-CR-152409) Avail: NTIS HC A09/MF A01 CSCL
17G

Work performed on the low cost airborne Microwave Landing System (MLS) receiver is summarized. A detailed description of the prototype low cost MLS receiver is presented. This detail includes block diagrams, schematics, board assembly drawings, photographs of subassemblies, mechanical construction, parts lists, and microprocessor software. Test procedures are described and results are presented. T.M.

N81-12110* Systems Technology, Inc., Hawthorne, Calif.
**PRACTICAL OPTIMAL FLIGHT CONTROL SYSTEM DESIGN
FOR HELICOPTER AIRCRAFT. VOLUME 2: SOFTWARE
USER'S GUIDE Final Report**
Susan A. Riedel Mar. 1979 254 p refs
(Contract NAS2-9946)
(NASA-CR-152306; TR-1127-1-Vol-2) Avail: NTIS
HC A12/MF A01 CSCL 01C

A method by which modern and classical control theory techniques may be integrated in a synergistic fashion and used in the design of practical flight control systems is presented. A general procedure is developed, and several illustrative examples

are included. Emphasis is placed not only on the synthesis of the design, but on the assessment of the results as well. The first step is to establish the differences, distinguishing characteristics and connections between the modern and classical control theory approaches. Ultimately, this uncovers a relationship between bandwidth goals familiar in classical control and cost function weights in the equivalent optimal system. In order to obtain a practical optimal solution, it is also necessary to formulate the problem very carefully, and each choice of state, measurement and output variable must be judiciously considered. Once design goals are established and problem formulation completed, the control system is synthesized in a straightforward manner. Three steps are involved: filter-observer solution, regulator solution, and the combination of those two into the controller. Assessment of the controller permits and examination and expansion of the synthesis results. J.M.S.

N81-18418*# Florida Univ., Gainesville. Dept. of Engineering Sciences.

VELOCITY FIELD NEAR THE JET ORIFICE OF A ROUND JET IN A CROSSFLOW Interim Report

Richard L. Fearn and J. Paul Benson Dec. 1979 72 p refs (Grants Nsg-2288; NGL-10-005-127) (NASA-CR-152353) Avail: NTIS HC A04/MF A01 CSCL 20D

Experimentally determined velocities at selected locations near the jet orifice are presented and analyzed for a round jet in crossflow. Jet to cross flow velocity ratios of four and eight were studied experimentally for a round subsonic jet of air exhausting perpendicularly through a flat plate into a subsonic crosswind of the same temperature. Velocity measurements were made in cross sections to the jet plume located from one to four jet diameters from the orifice. Jet centerline and vortex properties are presented and utilized to extend the results of a previous study into the region close to the jet orifice. Author

N81-16975*# Analytical Methods, Inc., Bellevue, Wash.
A THREE-DIMENSIONAL VISCOUS/POTENTIAL FLOW INTERACTION ANALYSIS METHOD FOR MULTI-ELEMENT WINGS: MODIFICATIONS TO THE POTENTIAL FLOW CODE TO ALLOW PART-SPAN, HIGH-LIFT DEVICES AND CLOSE-INTERFERENCE CALCULATIONS

B. Maskew Mar. 1979 143 p refs (Contract NAS2-8788) (NASA-CR-152277) Avail: NTIS HC A07/MF A01 CSCL 01A

The description of the modified code includes details of a doublet subpanel technique in which panels that are close to a velocity calculation point are replaced by a subpanel set. This treatment gives the effect of a higher panel density without increasing the number of unknowns. In particular, the technique removes the close approach problem of the earlier singularity model in which distortions occur in the detailed pressure calculation near panel corners. Removal of this problem allowed a complete wake relaxation and roll-up iterative procedure to be installed in the code. The geometry package developed for the new technique and also for the more general configurations is based on a multiple patch scheme. Each patch has a regular array of panels, but arbitrary relationships are allowed between neighboring panels at the edges of adjacent patches. This provides great versatility for treating general configurations. T.M.

N81-18028*# Kaman Aerospace Corp., Bloomfield, Conn.
MULTICYCLIC CONTROLLABLE TWIST ROTOR DATA ANALYSIS Final Report

Fu-Shang Wei and A. L. Weisbrich 15 Jan. 1979 170 p refs (Contract NAS2-8726) (NASA-CR-152251; R-1562) Avail: NTIS HC A08/MF A01 CSCL 01A

Results provide functional relationship between rotor performance, blade vibratory loads and dual control settings and indicate that multicyclic control produced significant reductions in blade flatwise bending moments and blade root actuator control loads. Higher harmonic terms of servo flap deflection were found to be most pronounced in flatwise bending moment, transmission vertical vibration and pitch link vibratory load equations. The existing test hardware represents a satisfactory configuration for demonstrating MCTR technology and defining a data base for additional wind tunnel testing. T.M.

N81-18060*# Lear Siegler, Inc., Santa Monica, Calif. Astronics Div.

DEVELOPMENT AND EVALUATION OF AUTOMATIC LANDING CONTROL LAWS FOR POWER LIFT STOL AIRCRAFT Final Report

B. Feinreich and G. Gevaert Jan. 1981 258 p (Contract NAS2-10324) (NASA-CR-152399) Avail: NTIS HC A12/MF A01 CSCL 01C

A series of investigations were conducted to generate and verify through ground bases simulation and flight research a data base to aid in the design and certification of advanced propulsive lift short takeoff and landing aircraft. Problems impacting the design of powered lift short haul aircraft that are to be landed automatically on STOL runways in adverse weather were examined. An understanding of the problems was gained by a limited coverage of important elements that are normally included in the certification process of a CAT 3 automatic landing system. T.M.

N81-18319*# Florida State Univ., Gainesville.
VELOCITY FIELD NEAR THE JET ORIFICE OF A ROUND JET IN A CROSSFLOW

Richard L. Fearn and J. Paul Benson Dec. 1979 72 p refs (Grants Nsg-2288; NGL-10-005-127) (NASA-CR-152293) Avail: NTIS HC A04/MF A01 CSCL 20D

Experimentally determined velocities at selected locations near the jet orifice are presented and analyzed for a round jet in crossflow. Jet-to-crossflow velocity ratios of four and eight were studied experimentally for a round subsonic jet of air exhausting perpendicularly through a flat plate into a subsonic crosswind of the same temperature. Velocity measurements were made in cross sections to the jet plume located from one to four jet diameters from the orifice. Jet centerline and vortex properties are presented and utilized to extend the results of a previous study into the region close to the jet orifice. Author

N81-18798*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

FORWARD VELOCITY EFFECTS ON FAN NOISE AND THE SUPPRESSION CHARACTERISTICS OF ADVANCED INLETS AS MEASURED IN THE NASA AMES 40 BY 80 FOOT WIND TUNNEL: ACOUSTIC DATA REPORT Final Report

Michael T. Moore Jan. 1981 262 p refs (Contract NAS2-8675) (NASA-CR-152329) Avail: NTIS HC A12/MF A01 CSCL 20A

Forward velocity effects on the forward radiated fan noise and on the suppression characteristics of three advanced inlets relative to a baseline cylindrical inlet were measured in a wind tunnel. A modified JT15D turbofan engine in a quiet nacelle was the source of fan noise; the advanced inlets were a CTOL hybrid inlet, an STOL hybrid inlet, and a treated deflector inlet. Also measured were the static to flight effects on the baseline inlet noise and the effects on the fan noise of canting the baseline inlet 4 deg downward to simulate typical wing mounted turbofan engines. The 1/3 octave band noise data from these tests are given along with selected plots of 1/3 octave band spectra and directivity and full scale PNL directivities. The test facilities and data reduction techniques used are also described. M.G.

N81-19018* Nielsen Engineering and Research, Inc., Mountain View, Calif.

THEORETICAL ANALYSIS OF AN AUGMENTOR WING FOR A VTOL FIGHTER Final Report, May 1977 - Dec. 1978

Marnix F. E. Dillenius and Michael R. Mendenhall May 1979 53 p refs Sponsored in part by Navy

(Contract NAS2-9605)

(NASA-CR-152254; NEAR-TR-183)

Avail: NTIS

HC A04/MF A01 CSCL 01A

A method based on potential flow theory was developed for predicting forces and moments acting on augmentor wings for prescribed ejector jet characteristics. A three dimensional nonplanar vortex lattice is laid out on the chordal planes of the augmentor wing components. Jet induced effects are included in the boundary condition from which the horseshoe vortex strengths are obtained. The jet within the diffuser is made to expand from the primary nozzles to the diffuser exit and is represented by a distribution of vorticity on the jet boundary to provide proper entrainment. The jet downstream of the diffuser exit is modeled by a vorticity distribution and blockage panels and its centerline location and spreading rate are taken from experimental data. The vortex lattice and jet models are used in an iterative manner until the predicted diffuser exit velocity matches the specified one. Some comparisons with available data show good agreement at lower power settings. Author

N81-19095* Grumman Aerospace Corp., Bethpage, N.Y.

VTOL IN GROUND EFFECT FLOWS FOR CLOSELY SPACED JETS Final Report

David Migdal, William G. Hill, Jr., and Richard C. Jenkins Dec. 1979 195 p refs

(Contract NAS2-10097)

(NASA-CR-152321) Avail: NTIS HC A09/MF A01 CSCL 01C

Results of a series of in ground effect twin jet tests are presented along with flow models for closely spaced jets to help predict pressure and upwash forces on simulated aircraft surfaces. The isolated twin jet tests revealed unstable fountains over a range of spacings and jet heights, regions of below ambient pressure on the ground, and negative pressure differential in the upwash flow field. A separate computer code was developed for vertically oriented, incompressible jets. This model more accurately reflects fountain behavior without fully formed wall jets, and adequately predicts ground isobars, upwash dynamic pressure decay, and fountain lift force variation with height above ground. E.A.K.

N81-19096* Douglas Aircraft Co., Inc., Long Beach, Calif.
ANALYTICAL STUDY OF STOL AIRCRAFT IN GROUND EFFECT. PART 1: NONPLANAR, NONLINEAR WING/JET LIFTING SURFACE METHOD

C. A. Shollenberger and D. N. Smyth Mar. 1978 91 p refs

(Contract NAS2-9319)

(NASA-CR-152087-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 01C

A nonlinear, nonplanar three dimensional jet flap analysis, applicable to the ground effect problem, is presented. Lifting surface methodology is developed for a wing with arbitrary planform operating in an inviscid and incompressible fluid. The classical, infinitely thin jet flap model is employed to simulate power induced effects. An iterative solution procedure is applied within the analysis to successively approximate the jet shape until a converged solution is obtained which closely satisfies jet and wing boundary conditions. Solution characteristics of the method are discussed and example results are presented for unpowered, basic powered and complex powered configurations. Comparisons between predictions of the present method and experimental measurements indicate that the improvement of the jet with the ground plane is important in the analyses of powered lift systems operating in ground proximity. Further development of the method is suggested in the areas of improved solution convergence, more realistic modeling of jet impingement and calculation efficiency enhancements. Author

N81-19097* Douglas Aircraft Co., Inc., Long Beach, Calif.
ANALYTICAL STUDY OF STOL AIRCRAFT IN GROUND EFFECT. PART 2: NONPLANAR, NONLINEAR METHOD APPLICABLE TO THREE DIMENSIONAL JETS OF FINITE THICKNESS

C. A. Shollenberger Mar. 1978 36 p refs

(Contract NAS2-9319)

(NASA-CR-152088-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 01C

The ability of the potential flow analysis (POTFAN) to predict the influence of ground proximity on lift systems is examined. A two dimensional study employing vortex lattice methodology provides confidence that ground effect phenomenon can be predicted using discrete singularity representation. Two dimensional quasi-steady ascent and descent behavior determined provides guidance in interpreting three dimensional results. Steady and quasi-steady ground effect aerodynamic characteristics predicted by POTFAN are presented for several basic unpowered configurations. POTFAN results are compared with experimental data and results of other analytical methods. Modification of POTFAN to incorporate multienergy flow analysis is discussed. General aspects of thick jet models are examined to provide a basis for extending POTFAN's scope to include analysis of propulsive lift interactions. S.F.

N81-19111* RAND Corp., Santa Monica, Calif.

PREDICTING COST/RELIABILITY/MAINTAINABILITY OF ADVANCED GENERAL AVIATION AVIONICS EQUIPMENT Final Report

M. R. Davis, M. Kamins, and W. E. Mooz Jun. 1978 126 p refs

(Contract NAS2-9450)

(NASA-CR-152149; RAND/WN-10233-NASA) Avail: NTIS HC A07/MF A01 CSCL 01D

A methodology is provided for assisting NASA in estimating the cost, reliability, and maintenance (CRM) requirements for general aviation equipment operating in the 1980's. Practical problems of predicting these factors are examined. The usefulness and short comings of different approaches for modeling cost and reliability estimates are discussed together with special problems caused by the lack of historical data on the cost of maintaining general aviation avionics. Suggestions are offered on how NASA might proceed in assessing cost reliability CRM implications in the absence of reliable generalized predictive models. A.R.H.

N81-19112* Sperry Flight Systems, Phoenix, Ariz.

V/STOL AND DIGITAL AVIONICS SYSTEM FOR UH-1H Final Report

Sam Liden Oct. 1978 216 p refs

(Contract NAS2-7306)

(NASA-CR-152179) Avail: NTIS HC A10/MF A01 CSCL 01D

A hardware and software system for the Bell UH-1H helicopter was developed that provides sophisticated navigation, guidance, control, display, and data acquisition capabilities for performing terminal area navigation, guidance and control research. Two Sperry 1819B general purpose digital computers were used. One contains the development software that performs all the specified system flight computations. The second computer is available to NASA for experimental programs that run simultaneously with the other computer programs and which may, at the push of a button, replace selected computer computations. Other features that provide research flexibility include keyboard selectable gains and parameters and software generated alphanumeric and CRT displays. T.M.

N81-19136* Systems Control, Inc., Palo Alto, Calif.

SIMULATION AND CONTROL ENGINEERING STUDIES OF NASA-AMES 40 FOOT BY 80 FOOT/80 FOOT BY 120 FOOT WIND TUNNELS Final Report, Aug. 1977 - Mar. 1978

Jeff G. Bohn and J. Edwin Jones 26 May 1978 316 p refs
(Contract NAS2-9665)
(NASA-CR-152145) Avail: NTIS HC A14/MF A01 CSCL 14B

The development and use of a digital computer simulation of the proposed wind tunnel facility is described. The feasibility of automatic control of wind tunnel airspeed and other parameters was examined. Specifications and implementation recommendations for a computer based automatic control and monitoring system are presented. T.M.

N81-21015* Stanford Univ., Calif. Joint Inst. for Aeronautics and Acoustics.

A SEMI-ANALYTIC APPROACH TO THE SELF INDUCED MOTION OF VORTEX SHEETS

Leonard W. Schwartz May 1980 42 p refs

(Contract NCC2-55)

(NASA-CR-164177; SU-JIAA-TR-32)

Avail: NTIS

HC A03/MF A01 CSCL 01A

The rolling up of the trailing vortex sheet produced by a wing of finite span was calculated as a series expansion in time. For a vorticity distribution corresponding to a wing with cusped tips, the shape of the sheet was found by summing the series using Pade approximants. The sheet remains analytic for some time but ultimately develops an exponential spiral at the tips. The centroid of vorticity was conserved to high accuracy. R.C.T.

N81-21309* Stanford Univ., Calif. Joint Inst. for Aeronautics and Acoustics.

ON THE PRESSURE FIELD OF NONLINEAR STANDING WATER WAVES

Leonard W. Schwartz May 1980 20 p refs

(Contract NCC2-55)

(NASA-CR-164181; SU-JIAA-TR-33)

Avail: NTIS

HC A02/MF A01 CSCL 20D

The pressure field produced by two dimensional nonlinear time and space periodic standing waves was calculated as a series expansion in the wave height. The high order series was summed by the use of Pade approximants. Calculations included the pressure variation at great depth, which was considered to be a likely cause of microseismic activity, and the pressure distribution on a vertical barrier or breakwater. R.C.T.

N81-21872* Stanford Univ., Calif. Joint Inst. for Aeronautics and Acoustics.

TRANSMITTED SOUND FIELD DUE TO AN IMPULSIVE LINE ACOUSTIC SOURCE BOUNDED BY A PLATE FOLLOWED BY A VORTEX SHEET

Toshiki Miura and C. C. Chao Jan. 1980 85 p refs

(Grant NSG-2007)

(NASA-CR-164180; SU-JIAA-TR-27)

Avail: NTIS

HC A05/MF A01 CSCL 20A

The propagation of sound due to a line acoustic source in the moving stream across a semiinfinite vortex sheet which trails from a rigid plate is examined in a linear theory for the subsonic case. A solution for the transmitted sound field is obtained with the aid of multiple integral transforms and the Wiener-Hopf technique for both the steady state (time harmonic) and initial value (impulsive source) situations. The contour of inverse transform and hence the decomposition of the functions are determined through causality and radiation conditions. The solution obtained satisfies causality and the full Kutta conditions. The transmitted sound field is composed of two waves in both the steady state and initial value problems. One is the wave scattered from the edge of the plate which is associated with the bow wave and the instability wave. These waves exist in the downstream sectors. The other is the wave transmitted through the vortex sheet which is also associated with the instability wave. Regional divisions of the transmitted sound field are identified. M.G.

N81-22047* Sperry Flight Systems, Phoenix, Ariz.

V/STOLAND DIGITAL AVIONICS SYSTEM FOR XV-15 TILT ROTOR Final Report

Sam P. Liden Jan. 1980 381 p

(Contract NAS2-10326)

(NASA-CR-152320) Avail: NTIS HC A17/MF A01 CSCL 01D

A digital flight control system for the tilt rotor research aircraft provides sophisticated navigation, guidance, control, display and data acquisition capabilities for performing terminal area navigation, guidance and control research. All functions of the XV-15 V/STOLAND system were demonstrated on the NASA-ARC S-19 simulation facility under a comprehensive dynamic acceptance test. The most noteworthy accomplishments of the system are: (1) automatic configuration control of a tilt-rotor aircraft over the total operating range; (2) total hands-off landing to touchdown on various selectable straight-in glide slopes and on a flight path that includes a two-revolution helix; (3) automatic guidance along a programmed three-dimensional reference flight path; (4) navigation data for the automatic guidance computed on board, based on VOR/DME, TACAN, or MLS naid data; and (5) integration of a large set of functions in a single computer, utilizing 16k words of storage for programs and data. A.R.H.

N81-23028* Lockheed-Georgia Co., Marietta.

TRAILING EDGE WAKE FLOW CHARACTERISTICS OF UPPER SURFACE BLOWN CONFIGURATIONS Final Report, Aug. 1977 - Dec. 1978

N. N. Reddy Dec. 1978 435 p refs

(Contract NAS2-9615)

(NASA-CR-152224; LG78ER0252)

Avail: NTIS

HC A19/MF A01 CSCL 01A

Mean and fluctuating flow characteristics in the wake of upper surface blown flap configurations are presented. Relative importance of the longitudinal and the transverse components of the wake flow turbulence for noise generation are evaluated using correlation between the near-field noise and the wake turbulence. Effects of the jet velocity, the initial turbulence in the jet, and the flap deflection angle on noise and wake flow characteristics are studied. The far-field noise data is compared with the existing empirical prediction method. The measured wake flow properties are compared with an analytical model used in the existing USB wake flow noise theory. The detailed wake flow profiles, wake flow turbulence space-time correlations, wake flow turbulence cross-power spectra, and near-field noise third octave band spectra are presented in the appendices. Author

N81-23029* Nielsen Engineering and Research, Inc., Mountain View, Calif.

A STUDY OF REAL JET EFFECTS ON THE SURFACE PRESSURE DISTRIBUTION INDUCED BY A JET IN A CROSSFLOW Final Report, 1 May 1980 - 1 Mar. 1981

Stanley C. Perkins, Jr. and Michael R. Mendenhall Mar. 1981 158 p refs

(Contract NAS2-10623)

(NASA-CR-166150; NEAR-TR-237)

Avail: NTIS

HC A08/MF A01 CSCL 01A

A study of jet exit profile, exit Mach number, swirl and turbulence level on jet-induced loadings for jets exhausting from a surface into a crossflow is presented. The importance of each of these real jet characteristics is assessed using available data. Where adequate surface pressure distribution data are available, a correlation method to predict surface pressure for a jet exhausting from an infinite flat plate is used either to attempt to develop a correlation based on the real jet characteristics or to model the effects of that characteristic. Data comparisons are presented for selected cases. Also, a summary of information on surface pressure distribution data for jet exhausting from flat plates into a subsonic crossflow is presented. Author

N81-23080*# Honeywell, Inc., Minneapolis, Minn. Avionics Div.
DEMONSTRATION ADVANCED AVIONICS SYSTEM (DAAS) FUNCTIONAL DESCRIPTION Interim Report
 15 Oct. 1980 197 p Prepared jointly with King Radio Corp., Olathe, Kans.
 (Contract NAS2-10021)
 (NASA-CR-152405) Avail: NTIS HC A09/MF A01 CSCL 01D

A comprehensive set of general aviation avionics were defined for integration into an advanced hardware mechanization for demonstration in a Cessna 402B aircraft. Block diagrams are shown and system and computer architecture as well as significant hardware elements are described. The multifunction integrated data control center and electronic horizontal situation indicator are discussed. The functions that the DAAS will perform are examined. This function definition is the basis for the DAAS hardware and software design. A.R.H.

N81-23093*# Drexel Univ., Philadelphia, Pa. Dept. of Mechanical Engineering and Mechanics.
APPLICATION OF VARIABLE STRUCTURE SYSTEM THEORY TO AIRCRAFT FLIGHT CONTROL Interim Report
 Anthony J. Calise, Isaac Kadushin, and Fred Kramer May 1981 42 p refs
 (Contract NAG2-8)
 (NASA-CR-164321) Avail: NTIS HC A03/MF A01 CSCL 01C

The current status of research on the application of variable structure system (VSS) theory to design aircraft flight control systems is summarized. Two aircraft types are currently being investigated: the Augmentor Wing Jet STOL Research Aircraft (AWJSRA), and AV-8A Harrier. The AWJSRA design considers automatic control of longitudinal dynamics during the landing phase. The main task for the AWJSRA is to design an automatic landing system that captures and tracks a localizer beam. The control task for the AV-8A is to track velocity commands in a hovering flight configuration. Much effort was devoted to developing computer programs that are needed to carry out VSS design in a multivariable frame work, and in becoming familiar with the dynamics and control problems associated with the aircraft types under investigation. Numerous VSS design schemes were explored, particularly for the AWJSRA. The approaches that appear best suited for these aircraft types are presented. Examples are given of the numerical results currently being generated. A.R.H.

N81-23343*# Stanford Univ., Calif.
ON SOURCE RADIATION Interim Report
 Harold Levine Apr. 1980 24 p refs
 (Contract NCC2-55)
 (NASA-CR-166176; SU-JIAA-TR-29) Avail: NTIS HC A02/MF A01 CSCL 20N

The power output from given sources is usually ascertained via an energy flux integral over the normal directions to a remote (far field) surface; an alternative procedure, which utilizes an integral that specifies the direct rate of working by the source on the resultant field, is described and illustrated for both point and continuous source distribution. A comparison between the respective procedures is made in the analysis of sound radiated from a periodic dipole source whose axis performs a periodic plane angular movement about a fixed direction. Thus, adopting a conventional approach, Sretenskii (1956) characterizes the rotating dipole in terms of an infinite number of stationary ones along a pair of orthogonal directions in the plane, and through the far field representation of the latter, arrives at a series development for the instantaneous radiated power, whereas the local manner of power calculation dispenses with the equivalent infinite aggregate of sources and yields a compact analytical result. Author

N81-23488*# Stanford Univ., Calif.
ON CERTAIN INTEGRALS WHICH PERTAIN TO THE FORCED VIBRATION OF PLATES Interim Report

Harold Levine Oct. 1979 24 p refs
 (Grant NSG-2215)
 (NASA-CR-166175; SU-JIAA-TR-28) Avail: NTIS HC A02/MF A01 CSCL 20L

The various plate integrals previously considered by Crighton (1972) are directly recast in a manner that permits their systematic development near the source point; and thus to dispense with manipulation of the velocity transform. The advantage is the ease with which distributed forces over the plate are incorporated into the analysis. After the procedure is introduced in connection with a line source problem and followed by consideration of a point source, the analogous problems relative to uniformly distributed forces over strips or circular areas of the plate receive attention. S.F.

N81-23829*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
PROPERTIES OF MULTIVARIABLE ROOT LOCI M.S. Thesis

Andrew Emil Yagle Jun. 1981 128 p refs
 (Grant NGL-22-009-124)
 (NASA-CR-164319; LIDS-TH-1090) Avail: NTIS HC A07/MF A01 CSCL 12A

Various properties of multivariable root loci are analyzed from a frequency domain point of view by using the technique of Newton polygons, and some generalizations of the SISO root locus rules to the multivariable case are pointed out. The behavior of the angles of arrival and departure is related to the Smith-MacMillan form of $G(s)$ and explicit equations for these angles are obtained. After specializing to first order and a restricted class of higher order poles and zeros, some simple equations for these angles that are direct generalizations of the SISO equations are found. The unusual behavior of root loci on the real axis at branch points is studied. The SISO root locus rules for break-in and break-out points are shown to generalize directly to the multivariable case. Some methods for computing both types of points are presented. Author

N81-23861*# Stanford Univ., Calif.
A NOTE ON SOUND RADIATION INTO A UNIFORMLY FLOWING FLUID Interim Report

Harold Levine Jan. 1980 17 p ref
 (Contract NCC2-55)
 (NASA-CR-166177; SU-JIAA-TR-31) Avail: NTIS HC A02/MF A01 CSCL 20A

Sound radiation generated by mechanical or vibratory source arrangements and, in some instances of planar or piston types, encompasses all magnitudes of the wavelength or frequency as well as disposition of the observation site. The comparative increase in average total radiated power from infinitesimally small or point sources of periodic strength, on passing from rest to steady rectilinear motion, depends only on Mach number in the noncompact case; and a formally analogous rise in output is linked, to the presence of a steady parallel flow past a rigid plane wall in which a compact circular piston executes normal oscillations. The perspective of effects connected with such a background is flow is widened by regard for an elongated or strip piston, which prototype permits a straightforward and general analysis. S.F.

N81-24023*# Boeing Vertol Co., Philadelphia, Pa.
FLAP SURVEY TEST OF A COMBINED SURFACE BLOWING MODEL: FLOW MEASUREMENTS AT STATIC FLOW CONDITIONS

Toshiyuki Fukushima Mar. 1978 64 p refs
 (Contract NAS2-9693)
 (NASA-CR-152124) Avail: NTIS HC A04/MF A01 CSCL 01A

The Combined Surface Blowing (CSB) V/STOL-lift/p propulsion system consists of a blown flap system which deflects the exhaust from a turbojet engine over a system of flaps deployed at the

trailing edge of the wing. Flow measurements consisting of velocity measurements using split film probes and total measure surveys using a miniature Kiel probe were made at control stations along the flap systems at two spanwise stations, the centerline of the nozzle and 60 percent of the nozzle span outboard of the centerline. Surface pressure measurements were made in the wing cove and the upper surface of the first flap element. The test showed a significant flow separation in the wing cove. The extent of the separation is so large that the flow into the first flap takes place only at the leading edge of the flap. The velocity profile measurements indicate that large spanwise (3 dimensional) flow may exist. T.M.

N81-24064* Flight Dynamics Research Corp., Van Nuys, Calif.
A JET-DIFFUSER FOR EJECTOR A V/STOL FIGHTER
 Contractor Final Report, Sep. 1979 - Apr. 1981
 Morton Alperin and Jiunn-Jeng Wu Feb. 1981 50 p refs
 Sponsored in part by Naval Air Development Center
 (Contract NAS2-10373)
 (NASA-CR-166161) Avail: NTIS HC A03/MF A01 CSCL 21E

A single ejector equipped with only one vector control jet and a diffuser flap was installed close to the leading edge of the strake of a one-fifth scale, semi-span model of the aircraft, without wing, canard, or tail surface. Tests of the system at a nozzle pressure ratio of 1.24 indicated a thrust augmentation of 1.92 and a thrust in the flight direction of about 12% of the total thrust under static conditions. An ejector stall occurred at a ratio of tunnel dynamic pressure to nozzle gage pressure of about 0.008. Ejector stall speed can be delayed by using a boundary layer control jet at the front inlet lip of the ejector. T.M.

N81-24831# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
DISCRETE-TIME STOCHASTIC CONTROL OF HYBRID SYSTEMS
 D. A. Castanon, H. J. Chizeck, and A. S. Willsky May 1980 6 p refs
 (Grant NGL-22-009-124; Contracts N00014-77-C-0224; ET-76-C-01-2295)
 (NASA-CR-164261; AD-A098226; LIDS-P-998) Avail: NTIS HC A02/MF A01 CSCL 14/4

A simple class of discrete-time nonlinear stochastic control problems with quadratic costs for linear systems with randomly-jumping state-dependent parameters are solved using dynamic programming. The resulting controllers exhibit 'active hedging' properties. GRA

N81-25037* Washington Univ., Seattle.
AN EXPERIMENTAL INVESTIGATION OF THREE DIMENSIONAL LOW SPEED MINIMUM INTERFERENCE WIND TUNNEL FOR HIGH LIFT WINGS
 Shojiro Shindo and Robert G. Joppa Sep. 1980 24 p refs
 (Grant NsG-2260)
 (NASA-CR-164439) Avail: NTIS HC A02/MF A01 CSCL 01A

As a means to achieve a minimum interference correction wind tunnel, a partially actively controlled test section was experimentally examined. A jet flapped wing with 0.91 m (36 in) span and $R = 4.05$ was used as a model to create moderately high lift coefficients. The partially controlled test section was simulated using an insert, a rectangular box 0.96 x 1.44 m (3.14 x 4.71 ft) open on both ends in the direction of the tunnel air flow, placed in the University of Washington Aeronautical Laboratories (UWAL) 2.44 x 3.66 m (8 x 12 ft) wind tunnel. A tail located three chords behind the wing was used to measure the downwash at the tail region. The experimental data indicates that, within the range of momentum coefficient examined, it appears to be unnecessary to actively control all four sides of the test section walls in order to achieve the near interference free flow field environment in a small wind tunnel. The remaining wall interference can be satisfactorily corrected by the vortex lattice method. Author

N81-25130* Martin Marietta Corp., Denver, Colo.
INFRARED IMAGERY OF SHUTTLE (IRIS). TASK 1. SUMMARY REPORT
 Clifford J. Choccol Aug. 1977 31 p refs
 (Contract NAS2-9381)
 (NASA-CR-152123-Task-1-Summ; MCR-76-564-Task-1-Summ)
 Avail: NTIS HC A03/MF A01 CSCL 22B

The feasibility of remote, high-resolution infrared imagery of the Shuttle Orbiter lower surface during entry to obtain accurate measurements of aerodynamic heat transfer was demonstrated. Using available technology, such images can be taken from an existing aircraft/telescope system (the C141 A1RO) with minimum modification or addition of systems. Images with a spatial resolution of 1 m or better and a temperature resolution of 2.5% between temperatures of 800 and 1900 K can be obtained. Data reconstruction techniques can provide a geometrically and radiometrically corrected array on addressable magnetic tape ready for display by NASA. Author

N81-25723* Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
PRACTICAL ROBUSTNESS MEASURES IN MULTIVARIABLE CONTROL SYSTEM ANALYSIS Ph.D. Thesis
 Norman August Lahtomaki May 1981 278 p refs
 (Grant NGL-22-009-124; Contract DE-AC01-78RA-03395)
 (NASA-CR-164379; LIDS-TH-1093) Avail: NTIS HC A13/MF A01 CSCL 09B

The robustness of the stability of multivariable linear time invariant feedback control systems with respect to model uncertainty is considered using frequency domain criteria. Available robustness tests are unified under a common framework based on the nature and structure of model errors. These results are derived using a multivariable version of Nyquist's stability theorem in which the minimum singular value of the return difference transfer matrix is shown to be the multivariable generalization of the distance to the critical point on a single input, single output Nyquist diagram. Using the return difference transfer matrix, a very general robustness theorem is presented from which all of the robustness tests dealing with specific model errors may be derived. The robustness tests that explicitly utilized model error structure are able to guarantee feedback system stability in the face of model errors of larger magnitude than those robustness tests that do not. The robustness of linear quadratic Gaussian control systems are analyzed. M.G.

N81-26072* Stanford Univ., Calif.
STRAKE/DELTA WING INTERACTIONS AT HIGH ANGLES OF ATTACK
 M. I. G. Bloor and R. A. Evans Apr. 1980 36 p refs
 (Contract NCC2-55)
 (NASA-CR-166183; SU-JIAA-TR-30) Avail: NTIS HC A03/MF A01 CSCL 01A

The method of vortex discretization is used to analyze the interaction of the vorticity generated by a strake, with the flow over a delta wing. The validity of the approach is first established by making comparisons with established methods for dealing with delta wings, after which compound delta planforms are discussed. An understanding of the favorable interference effects normally associated with this type of configuration is obtained and results are presented to quantify the expected lift increments resulting from the strake interaction. Author

N81-27852* Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
EQUATIONS FOR THE ANGLES OF ARRIVAL AND DEPARTURE FOR MULTIVARIABLE ROOT LOCI USING FREQUENCY-DOMAIN METHODS
 Andrew E. Yagle Jul. 1981 14 p refs
 (Grant NGL-22-009-124)
 (NASA-CR-164551; LIDS-P-1104) Avail: NTIS HC A02/MF A01 CSCL 12A

Frequency domain methods are used to study the angles of arrival and departure for multivariable root loci. Explicit equations are obtained. For a special class of poles and zeros, some simpler equations that are generalizations of the single input/single output equations are presented. M.G.

N81-28084*# Vought Corp., Dallas, Tex.
A MATHEMATICAL MODEL FOR VERTICAL ATTITUDE TAKEOFF AND LANDING (VATOL) AIRCRAFT SIMULATION. VOLUME 1: MODEL DESCRIPTION APPLICATION Final Report
 Robert L. Fortenbaugh Dec. 1980 228 p refs 3 Vol.
 (Contract NAS2-10294)
 (NASA-CR-166129-Vol-1) Avail: NTIS HC A11/MF A01 CSCL 01C

A mathematical model of a high performance airplane capable of vertical attitude takeoff and landing (VATOL) was developed. An off line digital simulation program incorporating this model was developed to provide trim conditions and dynamic check runs for the piloted simulation studies and support dynamic analyses of proposed VATOL configuration and flight control concepts. Development details for the various simulation component models and the application of the off line simulation program, Vertical Attitude Take-Off and Landing Simulation (VATLAS), to develop a baseline control system for the Vought SF-121 VATOL airplane concept are described. E.A.K.

N81-28085*# Vought Corp., Dallas, Tex.
A MATHEMATICAL MODEL FOR VERTICAL ATTITUDE TAKEOFF AND LANDING (VATOL) AIRCRAFT SIMULATION. VOLUME 2: MODEL EQUATIONS AND BASE AIRCRAFT DATA
 Robert L. Fortenbaugh Dec. 1980 90 p refs 3 Vol.
 (Contract NAS2-10294)
 (NASA-CR-166129-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 01C

Equations incorporated in a VATOL six degree of freedom off-line digital simulation program and data for the Vought SF-121 VATOL aircraft concept which served as the baseline for the development of this program are presented. The equations and data are intended to facilitate the development of a piloted VATOL simulation. The equation presentation format is to state the equations which define a particular model segment. Listings of constants required to quantify the model segment, input variables required to exercise the model segment, and output variables required by other model segments are included. In several instances a series of input or output variables are followed by a section number in parentheses which identifies the model segment of origination or termination of those variables. E.A.K.

N81-28086*# Vought Corp., Dallas, Tex.
A MATHEMATICAL MODEL FOR VERTICAL ATTITUDE TAKEOFF AND LANDING (VATOL) AIRCRAFT SIMULATION. VOLUME 3: USER'S MANUAL FOR VATOL SIMULATION PROGRAM
 Robert L. Fortenbaugh Dec. 1980 425 p refs 3 Vol.
 (Contract NAS2-10294)
 (NASA-CR-166129-Vol-3) Avail: NTIS HC A18/MF A01 CSCL 01C

Instructions for using Vertical Attitude Takeoff and Landing Aircraft Simulation (VATLAS), the digital simulation program for application to vertical attitude takeoff and landing (VATOL) aircraft developed for installation on the NASA Ames CDC 7600 computer system are described. The framework for VATLAS is the Off-Line Simulation (OLSIM) routine. The OLSIM routine provides a flexible framework and standardized modules which facilitate the development of off-line aircraft simulations. OLSIM runs under the control of VTOLTH, the main program, which calls the proper modules for executing user specified options. These options include trim, stability derivative calculation, time history generation, and various input-output options. E.A.K.

N81-29134*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
ALLEVIATION OF HELICOPTER FUSELAGE-INDUCED ROTOR UNSTEADY LOADS THROUGH DETERMINISTIC VARIATION OF THE INDIVIDUAL BLADE PITCH
 Mohammad A. Rahnema May 1981 72 p refs
 (Contract NsG-2266)
 (NASA-CR-166234; ASRL-TR-196-2) Avail: NTIS HC A04/MF A01 CSCL 01C

The effect of fuselage-induced upwash on the flapwise motion of a hinged rotor blade is considered. The typical upwash field is simulated through the flow produced by a moving point source. The resulting blade response is then approximated by its rigid flapping and first bending mode. The perturbation blade pitch variation required to alleviate its response to the upwash in the sense of either reducing the increased hub shear or minimization of the blade overall time averaged deflection, is determined. Calculations are carried out for a model rotor and for the case with increased Lock number. The results are presented in graph form. It is found that the minimum blade deflection criteria suppress the rigid flapping by a large amount and reduce the peak-to-peak value of the blade hub shear by at least 50 percent without causing an additional increase in blade stresses. Author

N81-29135*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
TESTING AND EVALUATION OF A STALL-FLUTTER-SUPPRESSION SYSTEM FOR HELICOPTER ROTORS USING INDIVIDUAL-BLADE-CONTROL
 Todd R. Quackenbush Aug. 1981 82 p refs
 (Grant NsG-2266)
 (NASA-CR-166233; ASRL-TR-196-3) Avail: NTIS HC A05/MF A01 CSCL 01C

The development and testing of a feedback system designed to alleviate the violent blade first torsion mode oscillations associated with stall flutter are described. The system, based on previously developed M.I.T. Individual-Blade-Control hardware, employs blade-mounted accelerometers to sense torsional oscillations and feeds back rate information to increase the damping of the first torsion mode. A linear model of the blade and control system dynamics is developed and is used to give qualitative and quantitative guidance in the design process as well as to aid in analysis of experimental results. System performance in wind tunnel tests, both in hover and forward flight, is described, and evidence is given of the system's ability to provide substantial additional damping to stall-induced blade oscillations. Author

N81-31559*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
SEQUENTIAL DECISION RULES FOR FAILURE DETECTION
 Edward Y. Chow (Schlumberger-Doll Research, Ridgefield, Conn.) and Alan S. Willsky Jul. 1981 12 p refs
 (Grant NGL-22-009-124; Contract N00014-77-C-0224; NR Proj. 041-516)
 (NASA-CR-164847; AD-A102025; LIDS-P-1109) Avail: NTIS HC A02/MF A01 CSCL 12A

The formulation of the decision making of a failure detection process as a Bayes sequential decision problem (BSDP) provides a simple conceptualization of the decision rule design problem. As the optimal Bayes rule is not computable, a methodology that is based on the Bayesian approach and aimed at a reduced computational requirement is developed for designing suboptimal rules. A numerical algorithm is constructed to facilitate the design and performance evaluation of these suboptimal rules. The result of applying this design methodology to an example shows that this approach is a useful one. Author (GRA)

N81-31952*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
ON REGULATORS WITH A PRESCRIBED DEGREE OF STABILITY M.S. Thesis

Peng-Teng Peter Ng Aug. 1981 220 p refs
(Contract DE-AC01-78RA-03395; Grant NGL-22-009-124)
(NASA-CR-164732; LIDS-TH-1129) Avail: NTIS
HC A10/MF A01 CSCL 12B

Several important aspects of the Regulator with a Prescribed Degree of Stability (RPDS) methodology and its applications are considered. The solution of the time varying RPDS problem as well as the characterization of RPDS closed loop eigenstructure properties are obtained. Based on the asymptotic behavior of RPDS root loci, a one step algorithm for designing Regulators with Prescribed Damping Ratio (RPDR) is developed. The robustness properties of RPDS are characterized in terms of the properties of the return difference and the inverse return difference matrices for the RPDS state feedback loop. This class of regulators is found to possess excellent multiloop margins with respect to stability and degree of stability properties. The ability of RPDS design to tolerate changing operating conditions and unmodelled dynamics are illustrated with a multiterminal dc/ac power system example. The output feedback realization of RPDS requires the use of Linear Quadratic Gaussian (LQG) methodology. S.F.

N81-33162*# General Dynamics Corp., Fort Worth, Tex.
EVALUATION OF PRESSURE AND THERMAL DATA FROM A WIND TUNNEL TEST OF A LARGE-SCALE, POWERED, STOL FIGHTER MODEL Final Report, 4 Jun. 1980 - 4 Jun. 1981
G. A. Howell, E. L. Crosthwait, and M. C. Witte Jun. 1981 987 p refs
(Contract NAS2-10649)
(NASA-CR-166170) Avail: NTIS HC A99/MF A01 CSCL 01A

A STOL fighter model employing the vectored-engine-over wing concept was tested at low speeds in the NASA/Ames 40 by 80-foot wind tunnel. The model, approximately 0.75 scale of an operational fighter, was powered by two General Electric J-97 turbojet engines. Limited pressure and thermal instrumentation were provided to measure power effects (chordwise and spanwise blowing) and control-surface-deflection effects. An in-depth study of the pressure and temperature data revealed many flow field features - the foremost being wing and canard leading-edge vortices. These vortices delineated regions of attached and separated flow, and their movements were often keys to an understanding of flow field changes caused by power and control-surface variations. Chordwise blowing increased wing lift and caused a modest aft shift in the center of pressure. The induced effects of chordwise blowing extended forward to the canard and significantly increased the canard lift when the surface was stalled. Spanwise blowing effectively enhanced the wing leading-edge vortex, thereby increasing lift and causing a forward shift in the center of pressure. Author

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-13217 * # Simple method for prediction of aircraft noise contours. E. C. Stewart and T. M. Carson (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Aircraft*, vol. 17, Nov. 1980, p. 828-830.

A method for generating noise contours more rapidly and more simply than previously used programs is discussed. The method gives the area, the noise contour, and its extremities for an arbitrarily complex flight path for both takeoffs and landings with relative ease. The analysis reveals the fundamental nature of the contours and how the various factors that influence its size and shape enter into the analysis. It is noted that the effects of ground attenuation and shielding are omitted as they are important only on the initial portion of flight and are highly dependent upon aircraft configuration. However, the analysis shows that these effects could be included. It is emphasized the the single-event contour is an obvious choice for purposes of minimizing noise impact. S.S.

A81-22568 * A discrete vortex method for the non-steady separated flow over an airfoil. J. Katz (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Fluid Mechanics*, vol. 102, Jan. 1981, p. 315-328. 23 refs.

A discrete vortex method was used to analyze the separated non-steady flow about a cambered airfoil. The foil flow modelling is based on the thin lifting-surface approach, where the chordwise location of the separation point is assumed to be known from experiments or flow-visualization data. Calculated results provided good agreement when compared with the post-stall aerodynamic data of two airfoils. Those airfoil sections differed in the extent of travel of the separation point with increasing angle of attack. Furthermore, the periodic wake shedding was analyzed and its time-dependent influence on the airfoil was investigated. (Author)

A81-37258 * # Pursuit tracking and higher levels of skill development in the human pilot. R. A. Hess (NASA, Ames Research Center, Aircraft Guidance and Navigation Branch, Moffett Field, Calif.). *IEEE Transactions on Systems, Man, and Cybernetics*, vol. SMC-11, Apr. 1981, p. 262-273. 20 refs.

A model of the human pilot is offered for pursuit tracking tasks; the model encompasses an existing model for compensatory tracking. The central hypothesis in the development of this model states that those primary structural elements in the compensatory model responsible for the pilot's equalization capabilities remain intact in the pursuit model. In this latter case, effective low-frequency inversion of the controlled-element dynamics occurs by feeding-forward derived input rate through the equalization dynamics, with low-frequency phase droop minimized. The sharp reduction in low-frequency phase lag beyond that associated with the disappearance of phase droop is seen to accompany relatively low-gain feedback of vehicle output. The results of some recent motion cue research are discussed and interpreted in terms of the compensatory-pursuit display dichotomy. Tracking with input preview is discussed in a qualitative way. In terms of the model, preview is shown to demand no fundamental changes in structure or equalization and to allow the pilot to eliminate the effective time delays that accrue in the inversion of the controlled-element dynamics. Precognitive behavior is discussed, and a model that encompasses all the levels of skill development outlined in the successive organizations of perception theory is finally proposed. (Author)

A81-43017 * Identifiability of unknown noise covariance matrices for some special cases of a linear, time-invariant, discrete-time dynamic system. W. L. Tsang, J. D. Glover (Northeastern University, Boston, MA), and R. E. Bach (NASA, Ames Research Center, Moffett Field, CA). *IEEE Transactions on Automatic Control*, vol. AC-26, Aug. 1981, p. 970-974. 13 refs.

Two off-line schemes are proposed for the identification of unknown noise covariance matrices Q and R of a discrete-time dynamic system. The first scheme is based on a maximum a posteriori cost function utilizing smoothed state estimates, while the second is based on a maximum likelihood cost function utilizing filtered state estimates. Sensitivity of the cost functions to Q and R is analyzed for the following cases: (1) single-input single-output systems; (2) multiinput single-output systems; and (3) single-input multioutput systems with a diagonal R. Identifiability criteria are presented for the cases considered and demonstrated by examples. V.L.

A81-44648 * Clear air turbulence - An airborne alert system. L. P. Stearns, F. Caracena (NOAA, Environmental Research Laboratories, Boulder, CO), P. M. Kuhn (Northrop Services, Inc., Moffett Field, CA), and R. L. Kurkowski (NASA, Ames Research Center, Flight Systems Research Div., Moffett Field, CA). *Science*, vol. 213, Aug. 28, 1981, p. 1007, 1008. 5 refs.

An infrared radiometer system has been developed that can alert a pilot of an aircraft 2 to 9 minutes in advance of an encounter with clear air turbulence. The time between the warning and the clear air turbulence event varies with the flight altitude of the aircraft. In turbulence-free areas, the incidence of false alarms is found to be less than one in 3.4 hours of flight time compared to less than one per 10 hours of flight time in areas with turbulence. (Author)

A81-46456 * # Aircraft control-display analysis and design using the optimal control model of the human pilot. R. A. Hess (NASA, Ames Research Center, Aircraft Guidance and Navigation Branch, Moffett Field, CA). (*Institute of Electrical and Electronics Engineers, International Conference on Cybernetics and Society, Cambridge, MA, Oct. 8-10, 1980.*) *IEEE Transactions on Systems, Man, and Cybernetics*, vol. SMC-11, July 1981, p. 465-480. 23 refs.

The use of the optimal control model (OCM) of the human pilot as a design tool is discussed. A novel procedure for the assignment and selection of model parameters in the absence of experimental data is proposed. A technique for partitioning a weakly coupled, multiaxis task into approximate state-uncoupled, single-axis tasks is introduced. The resulting modeling technique is utilized in the design and analysis of an aircraft flight-director system. This flight-director design technique differs from previous related work using the OCM in that considerable effort is devoted to ensuring that the OCM-designed director exhibits the desirable frequency-domain characteristics associated with experimentally verified classical designs (e.g., K/s 'effective vehicle' characteristics, noninteracting controls). The implications of the technique in the design of automatic flight control systems which employ the human pilot as a performance assessor and failure detector are briefly discussed. (Author)

An electronic flight-guidance display format was designed for use in evaluations of the collimated head-up display concept applied to transport aircraft landing. In the design process of iterative evaluation and modification, some general principles, or guidelines, applicable to electronic flight displays were suggested. The usefulness of an indication of instantaneous inertial flightpath was clearly demonstrated. Evaluator pilot acceptance of the unfamiliar display concepts was very positive when careful attention was given to indoctrination and training. Author

N81-19052*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLIGHT TESTS OF A CLEAR-AIR TURBULENCE ALERTING SYSTEM

Richard L. Kurkowski, Peter M. Kuhn (Raven Systems and Research, Inc.), and Lois P. Stearns (NOAA) *In NASA, Langley Research Center The 1980 Aircraft Safety and Operating Probl.* Pt. 1 Mar. 1981 p 329-349 refs (For primary document see N81-19035 10-03)

Avail: NTIS HC A17/MF A01 CSCL 01C

The detection of clear-air turbulence (CAT) ahead of an aircraft in real-time by an infrared (IR) radiometer is discussed. It is noted that the alter time and reliability depend on the band-pass of the IR filter used and on the altitude of the aircraft. Results of flights tests indicate that a bandpass of 20 to 40 microns appears optimal for alerting the aircraft crew to CAT at times before encounter of 2 to 9 min. Alert time increases with altitude, as the atmospheric absorption determining the horizontal weighting is reduced. M.G.

F

CONFERENCE AND MEETING PAPERS

N81-19042*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FLIGHT TESTS OF IFR LANDING APPROACH SYSTEMS FOR HELICOPTERS

J. S. Bull, D. M. Hegarty, L. L. Peach, J. D. Phillips, D. J. Anderson, D. C. Dugan, and V. L. Ross *In NASA, Langley Research Center The 1980 Aircraft Safety and Operating Probl.* Pt. 1 Mar. 1981 p 145-164 refs (For primary document see N81-19035 10-03)

Avail: NTIS HC A17/MF A01 CSCL 01C

Joint NASA/FAA helicopter flight tests were conducted to investigate airborne radar approaches (ARA) and microwave landing system (MLS) approaches. Flight-test results were utilized to prove NASA with a data base to be used as a performance measure for advanced guidance and navigation concepts, and to provide FAA with data for establishment of TERPS criteria. The first flight-test investigation consisted of helicopter IFR approaches to offshore oil rigs in the Gulf of Mexico, using weather/mapping radar, operational pilots, and a Bell 212 helicopter. The second flight-test investigation consisted of IFR MLS approaches at Crows Landing (near Ames Research Center), with a Bell UH-1H helicopter, using NASA, FAA, and operational industry pilots. Tests are described and results discussed. A.R.H.

N81-19043*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A HEAD-UP DISPLAY FORMAT FOR TRANSPORT AIRCRAFT APPROACH AND LANDING

Richard S. Bray and Barry C. Scott (FAA) *In NASA, Langley Research Center The 1980 Aircraft Safety and Operating Probl.* Pt. 1 Mar. 1981 p 165-193 refs (For primary document see N81-19035 10-03)

Avail: NTIS HC A17/MF A01 CSCL 01C

A81-20466 * Application of trajectory optimization principles to minimize aircraft operating costs. J. A. Sorensen (Analytical Mechanics Associates, Inc., Mountain View, Calif.), S. A. Morello (NASA, Langley Research Center, Hampton, Va.), and H. Erzberger (NASA, Ames Research Center, Moffett Field, Calif.). In: *Conference on Decision and Control, and Symposium on Adaptive Processes*, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 1. (A81-20426 07-63) Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 415-421. 31 refs.

This paper summarizes various applications of trajectory optimization principles that have been or are being devised by both government and industrial researchers to minimize aircraft direct operating costs (DOC). These costs (time and fuel) are computed for aircraft constrained to fly over a fixed range. Optimization theory is briefly outlined, and specific algorithms which have resulted from application of this theory are described. Typical results which demonstrate use of these algorithms and the potential savings which they can produce are given. Finally, need for further trajectory optimization research is presented. (Author)

A81-20623 * # A head-up display for low-visibility approach and landing. R. S. Bray (NASA, Ames Research Center, Moffett Field, Calif.) and B. C. Scott (FAA, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting*, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0130. 13 p.

An electronic flight-guidance display format was designed for use in evaluations of the collimated head-up display concept in low-visibility landings of transport aircraft. In the design process of iterative evaluation and modification, some general principles, or guidelines, applicable to such flight displays were suggested. The usefulness of an indication of instantaneous inertial flightpath was clearly demonstrated, particularly in low-altitude transition to visual references. Evaluator pilot acceptance of the unfamiliar display concepts was very positive when careful attention was given to indoctrination and training. (Author)

A81-20694 * # Design and preliminary tests of an IR-airborne LLWS remote sensing system. F. Caracena (NOAA, Environmental Research Laboratories, Boulder, Colo.), P. M. Kuhn (Raven Systems and Research, Inc., Boulder, Colo.), and R. Kurkowski (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0239.* 7 p. 8 refs.

Recent history underscores the need for in-cockpit alerts of LLWS for takeoffs and landings. The 13-15 micron portion of the CO₂ molecular spectrum can be used to remote sense LLWS in and around thunderstorms. A radiometer with a designed look-distance of about 10 km remote senses an average air temperature along a forward, horizontal path. Wind shear alerts are based on the difference between this forward air temperature and the air temperature near the aircraft. Although spectral ranging, a major design improvement of an IR LLWS alert system, is not at present feasible with noncooled detectors, it is an important technique to keep in mind, given the rapid advance in IR technology. (Author)

N81-28161* # National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CARBON-FIBER TECHNOLOGY Final Report c24
C. Frederick Hansen and John A. Parker /In American Chemical Society The 16th Natl. Symp. on Polymers in the Serv. of Man 1980 p 125-130 refs (For primary document see N81-28146 19-23)

Avail: NTIS HC A09/MF A01 CSCL 11D

The state of the art of PAN based carbon fiber manufacture and the science of fiber behavior is surveyed. A review is given of the stabilization by oxidation and the subsequent carbonization of fibers, of the apparent structure of fibers deduced from scanning electron microscopy, from X-ray scattering, and from similarities with soft carbons, and of the known relations between fiber properties and heat treatment temperature. A simplified model is invoked to explain the electrical properties of fibers and recent quantum chemical calculations on atomic clusters are used to elucidate some aspects of fiber conductivity. Some effects of intercalation and oxidative modification of finished fibers are summarized. E.D.K.

N81-33143* # National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HISTORICAL OVERVIEW OF V/STOL AIRCRAFT TECHNOLOGY

Seth B. Anderson /In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 13 p (For primary document see N81-33137 24-01)

Avail: NTIS HC A12/MF A01 CSCL 01B

During the past 25 years over 60 V/STOL types were studied and flown with varying degrees of success. The requirements for satisfactory characteristics in several key technology areas are discussed and a review is made of various V/STOL aircraft for the purpose of assessing the success or failure of each design in meeting design requirements. This survey shows that in spite of many problems revealed, special operating techniques were developed to help circumvent deficiencies. For the most part performance and handling qualities limitations restricted operational evaluations. Flight operations emphasized the need for good STOL performance, good handling qualities, and stability and control augmentation. The majority of aircraft suffered adverse ground effects. T.M.

A81-40147 * # Navigation errors encountered using weather-mapping radar for helicopter IFR guidance to oil rigs. J. D. Phillips, J. S. Bull, D. M. Hegarty, and D. C. Dugan (NASA, Ames Research Center, Moffett Field, CA). In: American Helicopter Society, Annual Forum, 36th, Washington, DC, May 13-15, 1980, Proceedings. (A81-40136 18-01) Washington, DC, American Helicopter Society, 1980. 10 p. 5 refs. (AHS 80-16)

In 1978 a joint NASA-FAA helicopter flight test was conducted to examine the use of weather-mapping radar for IFR guidance during landing approaches to oil rig helipads. The following navigation errors were measured: total system error, radar-range error, radar-bearing error, and flight technical error. Three problem areas were identified: (1) operational problems leading to pilot blunders, (2) poor navigation to the downwind final approach point, and (3) pure homing on final approach. Analysis of these problem areas suggests improvement in the radar equipment, approach procedure, and pilot training, and gives valuable insight into the development of future navigation aids to serve the off-shore oil industry. (Author)

A81-40160 * # A piloted simulator investigation of static stability and stability/control augmentation effects on helicopter handling qualities for instrument approach. J. V. Lebacqz (NASA, Ames Research Center, Moffett Field, CA) and R. D. Forrest (FAA, Moffett Field, CA). In: American Helicopter Society, Annual Forum, 36th, Washington, DC, May 13-15, 1980, Proceedings. (A81-40136 18-01) Washington, DC, American Helicopter Society, 1980. 23 p. 15 refs. (AHS 80-30)

A ground simulator experiment was conducted on the Flight Simulator for Advanced Aircraft at Ames Research Center to investigate the influence of several static stability and stability/control augmentation design parameters on helicopter flying qualities during terminal area operations in instrument conditions. Effects of light turbulence were included. Two levels of static stability in each rotational axis (pitch, roll, yaw) were examined for a hingeless rotor configuration. The variations in pitch and roll were: (1) stable and (2) neutral static stability; in yaw there were two stable levels. Four types of stability/control augmentation were also examined for the lower level of static stability in each axis. This latter investigation covered three helicopter rotor types: hingeless, articulated, and teetering. Four pilots performed a total of 105 evaluations of these parameters for a representative VOR instrument approach task. Pilot rating results indicate the acceptability of neutral static stability longitudinally and laterally and the need for pitch-roll attitude augmentation to achieve a satisfactory system. (Author)

A81-40180 * # NASA/FAA flight-test investigation of helicopter microwave landing system approaches. I. L. Peach, Jr., J. S. Bull, D. J. Anderson, D. C. Dugan, V. L. Ross (NASA, Ames Research Center, Moffett Field, CA), A. W. Hunting, D. P. Pate, and J. C. Savage (FAA, Flight Standards National Field Office, Oklahoma City, OK). In: American Helicopter Society, Annual Forum, 36th, Washington, DC, May 13-15, 1980, Proceedings. (A81-40136 18-01) Washington, DC, American Helicopter Society, 1980. 22 p. (AHS 80-55)

The helicopter Microwave Landing System flight-test investigations, conducted by a joint NASA/FAA effort in order to gather statistical data for establishing terminal instrument procedures criteria, and to provide a performance data base for developing advanced MLS guidance concepts, are presented. The specific flight-test objectives were to: (1) develop acceptable angle-only MLS approach profiles; (2) determine tracking errors; (3) determine altitude loss during missed approach; (4) evaluate guidance display sensitivities; and (5) evaluate pilot acceptability. Fourteen pilots flew 140 manual (without stability augmentation) dual-pilot simulated instrument approaches in a UH-1H helicopter. The flight profiles flown included 3-, 6-, and 9-degree glideslope, centerline approaches to decision heights of 50, 100, and 150 ft, respectively. The angular guidance display sensitivities and the data acquisition system are also described. Eight major conclusions are made, and include the following: (1) the use of pitch attitude to control airspeed and collective to control glideslope was the preferred pilot technique for the steep glideslope approaches, and (2) angular guidance deviation indicator sensitivity requirements for helicopter MLS approaches to STOLports and heliports have been found to be significantly different from standard ILS sensitivities. K.S.

A81-44092 * # Analysis of aircraft longitudinal handling qualities. R. A. Hess (NASA, Ames Research Center, Moffett Field, CA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. (A81-44076 21-12) New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 138-145. 11 refs. (AIAA 81-1771)

The optimal control model (OCM) of the human pilot is applied to the study of aircraft handling qualities. Attention is focused primarily on longitudinal tasks. The modeling technique differs from previous applications of the OCM in that considerable effort is expended in simplifying the pilot/vehicle analysis. After briefly reviewing the OCM, a technique for modeling the pilot controlling higher order systems is introduced. Following this, a simple criterion for determining the susceptibility of an aircraft to pilot induced oscillations (PIO) is formulated. Finally, a model-based metric for pilot rating prediction is discussed. The resulting modeling procedure provides a relatively simple, yet unified approach to the study of a variety of handling qualities problems. (Author)

A81-44110 * # Investigation of control, display, and crew-loading requirements for helicopter instrument approach. J. V. Lebacqz, R. M. Gerdes (NASA, Ames Research Center, Moffett Field, CA), R. D. Forrest (FAA, Moffett Field, CA), and R. K. Merrill (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA). In: Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers. (A81-44076 21-12) New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 281-295. 19 refs. (AIAA 81-1820)

A ground simulation experiment was conducted on a flight simulator for advanced aircraft to investigate the influence and interaction of flight-control system, flight-director display, and crew-loading situation on helicopter flying qualities during terminal-area operations in instrument conditions. Six levels of control complexity were implemented on a representative helicopter model. The six levels of augmentation were examined with display variations consisting of raw elevation and azimuth data only and of raw data plus one-, two-, and three-cue flight directors. Crew-loading situations simulated for the control-display combinations were dual-pilot operation and single-pilot operation. Four pilots performed a total of 150 evaluations of combinations of these parameters for a representative microwave landing system approach task. Pilot rating results indicated the existence of a control-display trade-off for ratings of satisfactory, whereas ratings of adequate-but-unsatisfactory depended primarily on the control system; the control system required for ratings of adequate-but-unsatisfactory was clearly more complex for the single-pilot situation than that for the dual-pilot situation. (Author)

A81-44554 * # Kinematic properties of rotary-wing and fixed-wing aircraft in steady coordinated high-g turns. R. T. N. Chen (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1855*. 15 p. 24 refs.

An analytical approach to the study of flight dynamics of aircraft operating in a high-angle-of-attack flight regime and of helicopters operating in extreme thrust conditions is presented. Steady coordinated high-g turns are used to establish the initial equilibrium flight conditions near stall angles of attack. The kinematic properties of the aircraft in steady coordinated turns are examined: in high-g turns, pitch rate (independent of the angle of attack) is of a much larger magnitude than roll and yaw rate; a substantial roll rate is found to develop in steep turns for all angles of attack; the angle of attack also has a significant effect on the pitch attitude, with decreasing influence as the normal load factor increases. The exact small disturbance equations of motion of the aircraft in general steady turns are also developed for application to both rotary-wing and fixed-wing aircraft in extreme conditions. These equations are in a first-order, vector-matrix format, and are thus compatible with many efficient software packages developed in modern system theory. J.F.

A81-44556 * # Automatic helical rotorcraft descent and landing using a Microwave Landing System. L. A. McGee, J. D. Foster, and G. Xenakis (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1857*. 11 p. 5 refs.

A helical-approach concept is presented for Instrument Flight Rules (IFR) operation of rotorcraft into congested terminal areas where separation from high-speed jet traffic is highly desirable and the airport-precision-approach aid is a Microwave Landing System (MLS). The concept takes advantage of the fact that rotorcraft need not land on the main runway but can operate from a pad that lies on an MLS radial offset from the centerline. The results of 48 flights using a UH-1H helicopter and a research avionics system are presented. Three levels of navigation sophistication were also investigated. It is shown that an approach helix can be contained in a relatively small volume and that being within the Instrument Landing System (ILS) Category II window at a 30-m (100-ft) altitude is not a requirement for a successful hover over a landing pad. Only two of the three navigation systems provided estimates that allowed all flights to descend from hover to touchdown. (Author)

A81-46623 * # A flight investigation of static stability, control augmentation, and flight director influences on helicopter IFR handling qualities. J. V. Lebacqz, J. M. Weber (NASA, Ames Research Center, Moffett Field, CA), and L. D. Corliss (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. (A81-46603 22-01) Washington, DC, American Helicopter Society, 1981, p. 237-251. 15 refs.

A flight experiment was conducted using the NASA-Army V/STOLAND UH-1H variable-stability helicopter to investigate the influence of several longitudinal-static-stability, control-augmentation, and flight-director parameters on helicopter flying qualities during terminal area operations in instrument conditions. This experiment, which was part of a joint NASA/FAA program pertaining to helicopter IFR airworthiness, was designed to corroborate and extend previous ground simulation results obtained in this program. Variations examined included stable and neutral longitudinal control position gradients, rate-damping and attitude-command augmentation, and raw data versus flight-director displays. Pilot rating results agreed excellently with the ground simulation data, indicating an adequate instrument capability with rate-damping augmentation and neutral statics and the need for pitch-roll attitude augmentation to achieve a satisfactory system. (Author)

A81-46644 * # Influence of sideslip on the kinematics of the helicopter in steady coordinated turns. R. T. N. Chen and J. A. Jeske (NASA, Ames Research Center, Moffett Field, CA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. (A81-46603 22-01) Washington, DC, American Helicopter Society, 1981, p. 463-477. 16 refs.

A steep coordinated helical turn at extreme angles of attack with inherent sideslip is of primary interest in this study. Unlike fixed-wing aircraft, the helicopter in a steady coordinated turn will inherently sideslip. A set of exact kinematic equations describing this motion in steady helical turns has been developed, and a rational definition for the load factor that best characterizes a coordinated turn for a helicopter has been proposed. An analysis has also been completed on the effects of sideslip on the kinematic relationships in a coordinated turn which is based on new closed-form solutions which relate the aircraft angular rates and pitch and roll attitudes to the turn parameters, angle of attack, and sideslip. The results show that the bank angle of the aircraft can differ markedly from the tilt angle of the normal load factor and that the normal load factor can also differ substantially from the accelerometer reading along the vertical body axis of the aircraft. Generally, sideslip has a strong influence on the pitch attitude and roll rate of the helicopter. The study also indicates that pitch rate is independent of angle of attack

in a coordinated turn and that in the absence of sideslip, angular rates about the stability axes are independent of the aerodynamic characteristics of the aircraft. (Author)

A81-46646 * # A piloted simulation of the backup control system engagement for the YAH-64. C. L. Blanken, E. W. Aiken, R. K. Merrill (U.S. Army, Aeromechanics Laboratory, Moffett Field, CA), and V. L. Ross (NASA, Ames Research Center, Moffett Field, CA). In: American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings. (A81-46603 22-01) Washington, DC, American Helicopter Society, 1981, p. 484-492.

A piloted simulator experiment, designed to evaluate and optimize certain backup control system (BUCS) engagement parameters and to provide pilot familiarization with aircraft response prior to flight test of the BUCS in the YAH-64 Advanced Attack Helicopter, is described. Key elements of the simulation were the representation of a control system jam, the pilot's breaking of a shear pin in the jammed control, and the resultant BUCS engagement. To minimize the excursions in aircraft motion which could result from the pilot's control inputs after shear pin breakage, the BUCS control function is blended in gradually. The experiment's results indicate that optimum time to full control authority after shear pin breakage

is three seconds in all axes for certain critical tasks. Special pilot training in the recovery from a control system jam may be necessary to minimize unacceptably large aircraft transients in the off-axis. (Author)

A81-48369 * Time delays in flight simulator visual displays. D. F. Crane (NASA, Ames Research Center, Moffett Field, CA). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. (A81-48326 23-59) Arlington, VA, AFIPS Press, 1980, p. 552-557. 13 refs.

It is pointed out that the effects of delays of less than 100 msec in visual displays on pilot dynamic response and system performance are of particular interest at this time because improvements in the latest computer-generated imagery (CGI) systems are expected to reduce CGI displays delays to this range. Attention is given to data which quantify the effects of display delays in the range of 0-100 msec on system stability and performance, and pilot dynamic response for a particular choice of aircraft dynamics, display, controller, and task. The conventional control system design methods are reviewed, the pilot response data presented, and data for long delays, all suggest lead filter compensation of display delay. Pilot-aircraft system crossover frequency information guides compensation filter specification. G.R.

HELICOPTER AND POWERED LIFT TECHNOLOGY DIVISION

NASA TECHNICAL MEMORANDA

N81-20068*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RECENT PROGRESS IN V/STOL AIRCRAFT TECHNOLOGY Final Report
L. Roberts, W. Deckert, and D. Hickey Mar. 1981 13 p refs (NASA-TM-81281; A-8512) Avail: NTIS HC A02/MF A01 CSCL 01C

Results from wind tunnel and flight tests investigations for V/STOL aircraft are reviewed. Primary emphasis is given to technical results relating to three types of subsonic aircraft: a quiet STOL aircraft; a tilt rotor aircraft; and a turbofan V/STOL aircraft. Comparison and correlation between theoretical and experimental results and between wind tunnel and flight test results, is made. The quiet STOL aircraft technology results are primarily those derived from the NASA/Boeing Quiet Short Haul Technology (QSRA) program. The QSRA aircraft uses an upper surface blown flap and develops a usable engine-out landing approach lift coefficient of 5.5 and landing distances less than 1,000 ft. The tilt rotor aircraft technology results are those obtained from the NASA/Army/Navy/Bell (XV-15-TRRA) aircraft flight investigations. The TRRA is a twin rotor research aircraft capable of vertical takeoff and landing and cruise speeds of 300 knots. The turbofan V/STOL aircraft technology results are from static ground facility and wind tunnel investigations of a NASA/NAVY/Grumman full scale lift/cruise fan aircraft model, which features two tilting nacelles with TF-34 engines. Author

two dimensions based on data prescribed at points distributed irregularly over the plane. The approach is described in detail. The computer program that implements the algorithm is documented and listed. Author

N81-23039*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FULL-SCALE AERODYNAMIC CHARACTERISTICS OF A PROPELLER INSTALLED ON A SMALL TWIN-ENGINE AIRCRAFT WING PANEL
Philip R. Barlow, Victor R. Corsiglia, and Joseph Katz May 1981 22 p refs (NASA-TM-81285; A-8478) Avail: NTIS HC A02/MF A01 CSCL 01A

Full-scale measurements of shaft thrust and torque were made. Wind-tunnel speeds and blade angles were set for full-scale flight conditions. Excellent quality measurements were obtained of the thrust coefficient, the power coefficient, and the propeller efficiency for various values of the advance ratio and the blade incidence angle at 3/4-blade radius. A conventional propeller theory found in the literature was applied to the present results. Although thrust, power, and efficiency were somewhat overpredicted, the advance ratio for maximum efficiency was predicted quite accurately. It was found that, for some conditions, spinner drag could be significant. A simple correction that was based on the spinner base pressure substantially accounted for the changes in efficiency that resulted from this cause. T.M.

N81-23813*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A GENERAL ALGORITHM FOR THE CONSTRUCTION OF CONTOUR PLOTS
Wayne Johnson and Fred Silva (Informatics, Inc., Palo Alto, Calif.) Apr. 1981 107 p (NASA-TM-81287; A-8560; AVRADCOM-TR-81-A-9) Avail: NTIS HC A06/MF A01 CSCL 12A

An algorithm is described that performs the task of drawing equal level contours on a plane, which requires interpolation in

N81-24025*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMICS, AEROELASTICITY, AND STABILITY OF HANG GLIDERS. EXPERIMENTAL RESULTS
Ilan M. Kroo Apr. 1981 109 p refs Prepared in cooperation with Stanford Univ. (NASA-TM-81289) Avail: NTIS HC A06/MF A01 CSCL 01A

One-fifth-scale models of three basic ultralight glider designs were constructed to simulate the elastic properties of full scale gliders and were tested at Reynolds numbers close to full scale

values. Twenty-four minor modifications were made to the basic configurations in order to evaluate the effects of twist, reflex, dihedral, and various stability enhancement devices. Longitudinal and lateral data were obtained at several speeds through an angle of attack range of -30 deg to +45 deg with sideslip angles of up to 20 deg. The importance of vertical center of gravity displacement is discussed. Lateral data indicate that effective dihedral is lost at low angles of attack for nearly all of the configurations tested. Drag data suggest that lift-dependent viscous drag is a large part of the glider's total drag as is expected for thin, cambered sections at these relatively low Reynolds numbers.

A.R.H.

N81-28056* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE INFLUENCE OF UNSTEADY AERODYNAMICS ON HINGELESS ROTOR GROUND RESONANCE

Wayne Johnson Jul. 1981 47 p refs

(NASA-TM-81302; A-8635; USAVRADCOM-TR-81-B-16)
 Avail: NTIS HC A03/MF A01 CSCL 01A

Calculations of the model frequency and damping for a hingeless rotor on a gimbaled support in hover are compared with measured results for two configurations (differing in blade flap stiffness). Good correlation is obtained when an inflow dynamics model is used to account for the influence of the unsteady aerodynamics. The effect of the unsteady aerodynamics is significant for this rotor system. The inflow dynamics model introduces additional states corresponding to perturbations of the wake-induced velocity at the rotor disk. The calculations confirm the experimental observation that the inflow mode introduced by these additional states is measurable for one configuration but not for the other.

Author

N81-28390* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PERFORMANCE AND ANALYSIS OF A THREE-DIMENSIONAL NONORTHOGONAL LASER DOPPLER ANEMOMETER

Philip K. Snyder, Kenneth L. Orloff, and Kiyoshi Aoyagi Jul. 1981 42 p refs

(NASA-TM-81283; A-8629) Avail: NTIS HC A03/MF A01 CSCL 20D

A three dimensional laser Doppler anemometer with a nonorthogonal third axis coupled by 14 deg was designed and tested. A highly three dimensional flow field of a jet in a crossflow was surveyed to test the three dimensional capability of the instrument. Sample data are presented demonstrating the ability of the 3D LDA to resolve three orthogonal velocity components. Modifications to the optics, signal processing electronics, and data reduction methods are suggested.

E.A.K.

N81-32137* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A FULL-SCALE WIND TUNNEL INVESTIGATION OF A HELICOPTER BEARINGLESS MAIN ROTOR

William Warmbrodt and John L. McCloud, II Aug. 1981 287 p

(NASA-TM-81321; A-8696) Avail: NTIS HC A13/MF A01 CSCL 01C

A helicopter bearingless main rotor was tested. Areas of investigation included aeroelastic stability, aerodynamic performance, and rotor loads as a function of collective pitch setting, RPM, airspeed and shaft angle. The rotor/support system was tested with the wind tunnel balance dampers installed and, subsequently, removed. Modifications to the rotor hub were tested. These included a reduction in the rotor control system stiffness and increased flexbeam structural damping. The primary objective of the test was to determine aeroelastic stability of the fundamental flexbeam/blade chordwise bending mode. The rotor was stable for all conditions. Damping of the rotor chordwise bending mode increases with increased collective pitch angle at constant operating conditions. No significant decrease in rotor

damping occurred due to frequency coalescence between the blade chordwise fundamental bending mode and the support system.

R.C.T.

NASA CONTRACTOR REPORTS

N81-25074* General Electric Co., Cincinnati, Ohio.

DESIGN OF A V/STOL PROPULSION SYSTEM FOR A LARGE-SCALE FIGHTER MODEL Final Report

W. S. Willis May 1981 58 p refs

(Contract NAS2-10556)

(NASA-CR-166162; R81AEG257)

Avail: NTIS

HC A04/MF A01 CSCL 21E

Modifications were made to the existing Large-Scale STOL fighter model to simulate a V/STOL configuration. Modifications include the substitutions of two dimensional lift/cruise exhaust nozzles in the nacelles, and the addition of a third J97 engine in the fuselage to supply a remote exhaust nozzle simulating a Remote Augmented Lift System. A preliminary design of the inlet and exhaust ducting for the third engine was developed and a detailed design was completed of the hot exhaust ducting and remote nozzle.

Author

N81-29923* Stanford Univ., Calif. Joint Inst. for Aeronautics and Acoustics.

A NOTE ON SOUND RADIATION FROM DISTRIBUTED SOURCES

Harold Levine May 1979 10 p refs

(Grant NSG-2007)

(NASA-CR-166220; SU-JIAA-TR-25)

Avail: NTIS

HC A02/MF A01 CSCL 20A

The power output from a normally vibrating strip radiator is expressed in alternative general forms, one of these being chosen to refine and correct some particular estimates given by Heckl for different numerical ratios of strip width to wave length. An exact and explicit calculation is effected for sinusoidal velocity profiles when the strip width equals an integer number of half wave lengths.

Author

N81-14998* Beam Engineering, Inc., Sunnyvale, Calif.

STATIC SOURCE LOCATIONS FOR FOUR NOZZLES MOUNTED ON A J-85 ENGINE Final Report

Leif E. Hoglund Jan. 1979 236 p refs

(Contract NAS2-9399)

(NASA-CR-152401) Avail: NASA. Ames Research Center CSCL 21E

The test nozzles included a round 17.5 in. diameter variable flap ejector (VFE) nozzle, a round 'stovepipe' nozzle, and a 104 tube suppressor nozzle operated both with and without an ejector shroud. The velocities tested ranged from 600 to 1600 fps at an approximate total temperature of 1400 R. The axial position of the noise sources during static operation was determined by jet velocity, Strouhal number, and direction of propagation. The velocity dependence was more evident for the 104 tube suppressor nozzle than for the conical nozzles tested. The results for both the VFE conical nozzle and the stovepipe conical nozzle indicate source locations to be much closer to the jet exit plane than expected. Corrections for near field effects were found to differ slightly for each nozzle tested. The corrections presented are simply the differences between the measured near field levels and the required near field levels if spherical spreading is assumed from source to far field.

Author

N81-30084* Boeing Commercial Airplane Co., Seattle, Wash.
AN INVESTIGATION OF ENGINE INFLUENCE ON INLET PERFORMANCE

Brent K. Hodder 1981 88 p refs
(Contract NAS2-06017)
(NASA-CR-166136: D6-49228) Avail: NTIS
HC A05/MF A01 CSCL 01A

The performance of a conventional engine/inlet installation, in which inlet and engine flow field interaction occurs, was compared to the performance of the same inlet remote coupled to the engine. The remote coupled inlet configuration decouples the influence of the engine on the inlet flow field and simulates current small scale inlet test techniques in which inlet airflow is provided by a vacuum source or coupled engine. The investigation was conducted in the NASA-Ames 40- by 80-foot wind tunnel using a General Electric TF-34 turbofan engine and a subsonic inlet having an average inlet contraction ratio of 1.26. Test results indicated that engine interaction allows the inlet to operate with lower distortion levels at and beyond the separation angle-of-attack experienced without engine interaction. T.M.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-24048 * # Design for supercommuters. L. J. Williams (NASA, Langley Research Center, Hampton, Va.) and T. L. Galloway (NASA, Ames Research Center, Moffett Field, Calif.). *Astronautics and Aeronautics*, vol. 19, Feb. 1981, p. 20-23, 26-30. 15 refs.

Action to be taken to prepare to implement efficient, modern commuter aircraft for the 1990s is outlined. The increase in the contribution of jet fuel costs to aircraft direct operating costs (DOC) is noted as the motivation for the introduction of turboprop-powered commuter aircraft, which use 15-20% less fuel per seat mile at short stage lengths, to replace larger jet transports. Designs proposed by various manufacturers which will make use of existing technology for 19-, 30- and 50-seat aircraft capable of carrying a full payload of passengers and baggage for 600 n mi and optimized for minimum DOC over a 100-n mi stage length are presented, and the improvements in fuel usage, DOC and passenger comfort to be obtained with the use of advanced technology are pointed out. The goals and considered technologies of the dedicated small-transport aircraft technology program recommended by a commuter air transport subcommittee of the NASA Advisory Council Aeronautics Advisory Committee to speed the development of commuter technology are then presented, with attention given to efforts of analysis, design and testing of propulsion systems, structures, aerodynamics and systems intended to result in 16-24% savings in DOC and up to 40% savings in fuel. The commuter development plans of various manufacturers are also indicated. S.C.S.

A81-39896 * Development of a comprehensive analysis for rotorcraft. I - Rotor model and wake analysis. W. Johnson (NASA, Ames Research Center; U.S. Army, Aeromechanics Laboratory, Moffett Field, CA). *Vertica*, vol. 5, no. 2, 1989, p. 99-129. 22 refs.

The development of a comprehensive analytical model of rotorcraft aerodynamics and dynamics is described. Particular emphasis is given to describing the reasons behind the choices and decisions involved in constructing the model. The analysis is designed to calculate rotor performance, loads and noise; helicopter vibration and gust response; flight dynamics and handling qualities; and system aeroelastic stability. It is intended for use in the design, testing and evaluation of a wide class of rotors and rotorcraft, and to be the basis for further development of rotary wing theories. The general characteristics of the geometric, structural, inertial, and aerodynamic models used for the rotorcraft components are described, including the assumptions introduced by the chosen models and the resulting capabilities and limitations. Finally, some examples from recent applications of the analysis are given. (Author)

A81-41823 * Helicopter theory. W. Johnson (NASA, Ames Research Center, Moffett Field, CA; U.S. Army, Washington, DC). Princeton, N.J., Princeton University Press, 1980. 1110 p. 966 refs. \$95.

A comprehensive presentation is made of the engineering analysis methods used in the design, development and evaluation of helicopters. After an introduction covering the fundamentals of helicopter rotors, configuration and operation, rotary wing history, and the analytical notation used in the text, the following topics are discussed: (1) vertical flight, including momentum, blade element and vortex theories, induced power, vertical drag and ground effect; (2) forward flight, including in addition to momentum and vortex theory for this mode such phenomena as rotor flapping and its higher harmonics, tip loss and root cutout, compressibility and pitch-flap coupling; (3) hover and forward flight performance assessment; (4) helicopter rotor design; (5) rotary wing aerodynamics; (6) rotary wing structural dynamics, including flutter, flap-lag dynamics ground resonance and vibration and loads; (7) helicopter aeroelasticity; (8) stability and control (flying qualities); (9) stall; and (10) noise. O.C.

CONFERENCE AND MEETING PAPERS

N81-19007*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SMALL TRANSPORT AIRCRAFT TECHNOLOGY c05
Thomas L. Galloway / In NASA. Langley Research Center Advan. Aerodyn. and Active Controls Feb. 1981 p 85-104 refs (For primary document see N81-19001 10-01)
Avail: NTIS HC A09/MF A01 CSCL 01C

The results of contracted studies identifying the potential benefits of advanced technology are presented. Current in house studies and research efforts are discussed. An overview of the proposed technology elements in STAT research is presented. E.D.K.

A81-20540 * # Numerical optimization of circulation control airfoils. T. C. Tai (U.S. Naval Material Command, David W. Taylor Naval Ship Research and Development Center, Bethesda, Md.), G. H. Kidwell, Jr. (NASA, Ames Research Center, Helicopter and Powered Lift System Div., Moffett Field, Calif.), and G. N. Vanderplaats (U.S. Naval Postgraduate School, Monterey, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0016*. 8 p. 17 refs. Navy-supported research.

A numerical procedure for optimizing circulation control airfoils, which consists of the coupling of an optimization scheme with a viscous potential flow analysis for blowing jet, is presented. The desired airfoil is defined by a combination of three baseline shapes (cambered ellipse, and cambered ellipse with drooped and spiralled trailing edges). The coefficients of these shapes are used as design variables in the optimization process. Under the constraints of lift augmentation and lift-to-drag ratios, the optimal airfoils are found to lie between those of cambered ellipse and the drooped trailing edge, towards the latter as the angle of attack increases. Results agree qualitatively with available experimental data.

(Author)

A81-20596 * # Acoustics of rotors utilizing circulation control. M. Mosher (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0092*. 13 p. 7 refs.

The acoustic characteristics of circulation-controlled rotors are examined by comparing data from three full-scale rotors: a conventional rotor, the X-Wing rotor, and the Circulations Control Rotor.

Both the X-Wing rotor and Circulation Control Rotor had higher sound levels than the conventional rotor at identical advancing-tip Mach numbers. There is excess noise due to the compressor on the X-Wing rotor and excess broadband noise on the Circulation Control Rotor. The X-Wing rotor had lower sound levels than the conventional rotor at identical forward speeds because of the lower tip speed feasible with the use of circulation control. (Author)

A81-20633 * # **QSR Joint Navy/NASA sea trials.** S. Queen (U.S. Naval Air Test Center, Patuxent River, Md.) and J. Cochrane (NASA, Ames Research Center, Quiet Short-Haul Aircraft Office, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0152.* 10 p.

The Quiet Short-Haul Research Aircraft (QSR), used to conduct a broad program of terminal area and low speed propulsive-flight research, is discussed. Flight performance of the QSR is presented together with the results of the joint Navy/NASA flight program. It is found that both free-deck takeoffs and unarrested landings can be conducted with winds across the deck of zero to 35 knots on an aircraft carrier the size of the USS Kitty Hawk with all engines operating. QSR characteristics and aerodynamic data are included. C.R.

N81-33144* # National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RECENT PROGRESS IN V/STOL AIRCRAFT TECHNOLOGY

L. Roberts, W. Deckert, and D. Hickey. In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 10 p refs (For primary document see N81-33137 24-01) Avail: NTIS HC A12/MF A01 CSCL 01B

Recent results from wind-tunnel and flight-tests investigations for V/STOL aircraft were reviewed. Primary emphasis is given to technical results relating to three types of subsonic aircraft: a quiet STOL aircraft; a tilt rotor aircraft, and a turboprop V/STOL aircraft. Comparison and correlation between theoretical and experimental results, and between wind-tunnel and flight-test results, is made. The quiet STOL aircraft technology results are primarily those derived from the NASA/Boeing Quiet Short Haul Aircraft (QSR) program. The tilt rotor aircraft technology results are those obtained from the NASA/Army/Navy/Bell (XV-15-TRRA) aircraft flight investigations. The turboprop V/STOL aircraft technology results are from static ground facility and wind-tunnel investigations of a NASA/Navy/Grumman full-scale lift/cruise fan aircraft model, which features two tilting nacelles with TF-34 engines. T.M.

A81-38058 * # **Component research for future propulsion systems.** C. L. Walker, G. J. Weden (U.S. Army, Propulsion Laboratory, Cleveland, OH), and J. Zuk (NASA, Ames Research Center, Moffett Field, CA). *NATO, AGARD, Specialists' Meeting, 57th, Toulouse, France, May 11-14, 1981, Paper.* 14 p. 13 refs.

A review of factors related to the acquisition and life-cycle cost, and mission reliability of helicopters is given. The potential for advanced vehicle configurations with improvements in energy efficiency, operating economics, and characteristics to satisfy the demands of the future market are identified. Special attention is given to advanced propulsion systems and related component technologies, and system requirements, powerplants and component thrusts, compressor designs, combustion systems, turbine efficiency, blade tip treatment concepts and shaft dynamics are discussed in detail. E.B.

A81-39009 * # **On the structure of turbulent wakes and merging shear layers of multielement airfoils.** L. E. Olson and K. L. Orloff (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1238.* 18 p. 19 refs.

The structure of the attached turbulent flow in the vicinity of a NACA 4412 airfoil equipped with a single-slotted flap was studied. The airfoil/flap configuration was tested at a Mach number of 0.06 and a Reynolds number of 1.3×10^6 to the 6th in a 7- by 10-Foot Wind Tunnel. Surface-pressure measurements were made on the main airfoil and on the flap. Detailed measurements, obtained using a high-spatial-resolution laser Doppler anemometer, were made of the mean velocity flow field and of the second-order statistical quantities (Reynolds stresses) in the boundary layers, wakes, and merging shear layers. The experimental observations are compared with theoretical predictions of pressure, mean velocity, and Reynolds stress. (Author)

A81-40125 * **Identification of a linear model of rotor-fuselage dynamics from nonlinear simulation data.** R. W. DuVal and D. B. Mackie (NASA, Ames Research Center, Moffett Field, CA). In: *European Rotorcraft and Powered Lift Aircraft Forum, 6th, Bristol, England, September 16-19, 1980, Conference Papers, Part 2.* (A81-40076 18-01) Bristol, University of Bristol, 1980. 25 p. 7 refs.

Linear regression techniques are used to obtain 9- and 12-degree-of-freedom linear rotorcraft models from the input-output data generated by a nonlinear, blade-element rotorcraft simulation in hover. The resulting models are used to evaluate the coupling of the fuselage modes with the rotor flapping and lead-lag modes at various frequencies. New techniques are proposed and evaluated to improve the identification process, including a method of verifying the assumed model structure by using data sets generated at different input frequencies. (Author)

A81-42739 * **Wind-tunnel measurements of wing-canard interference and a comparison with various theories.** T. W. Feistel, V. R. Corsiglia, and D. B. Levin (NASA, Ames Research Center, Large Scale Aerodynamics Branch, Moffett Field, CA). *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 7-10, 1981, Paper 810575.* 16 p. 9 refs.

Wind-tunnel tests and analyses of the aerodynamics of wing-canard combinations for low speed applications are presented. Systematic tests are conducted in a 7 x 10 wind tunnel to explore various combinations of wing-canard vertical and horizontal positioning. The goals of the tests are (1) to investigate potential improved stalling characteristics over conventional tail-aft configurations, (2) to investigate the existence of a lift coefficient advantage, and (3) to determine induced drag levels. The measurements obtained are compared with calculations made using the Prandtl-Munk theory, and with a vortex-lattice panel code. Results indicate that the panel code gives excellent results for lift and induced drag at moderate lift coefficient, whereas Prandtl-Munk theory gives conservative results for induced drag. The application is a light transport aircraft used for short-haul operations. K.S.

A81-42749 * **Rotorcraft researchers and operators - Is there is common ground.** P. D. Talbot and W. J. Snyder (NASA, Ames Research Center, Aeronautical Systems Branch, Moffett Field, CA). *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 7-10, 1981, Paper 810589.* 18 p. 10 refs.

An investigation is conducted concerning the extent to which a program for rotorcraft research presented by NASA meets the user needs. Problems of civil operators are examined, taking into account

powerplants, reliability and maintainability, environment, noise and vibration, and lack of space for passengers' baggage. A description of applicable technology is provided, giving attention to aerodynamics and structures, propulsion, power transfer methodology, flight control, avionic systems, human factors, and vehicle configurations. One of the most difficult challenges in trying to bring research to bear on operator problems is that in general researchers are working on long-term solutions while operators are seeking short-term answers. Attention is also given to potential technological bright spots, higher risk technologies, highest technological risks, and advanced vehicle configurations. G.R.

A81-42777 * Full-scale study of the cooling system aerodynamics of an operating piston engine installed in a light aircraft wing panel. V. R. Corsiglia and J. Katz (NASA, Ames Research Center, Moffett Field, CA). *Society of Automotive Engineers, Business Aircraft Meeting and Exposition, Wichita, KS, Apr. 7-10, 1981, Paper 810623*. 13 p.

Measurements of the drag and of the nacelle internal pressures on a wing and nacelle that housed a horizontally opposed piston engine were made in the 40- by 80-Foot Wind Tunnel at Ames Research Center. These tests are follow-ons to earlier tests made with the same wing and nacelle but in which the engine was replaced with an electric motor and an adjustable orifice plate. In the initial tests the orifice plate was used to control the rate of cooling-air flow through the nacelle and thereby to simulate a range of gasoline engine types. Good agreement was found between the results of those tests and of the test reported here. Also, the upper and lower plenum pressure and cooling-air flow rate were found to be related by conventional equations used to represent the flow through orifices. Tests were run with three cooling air inlet sizes over a free-stream velocity range from 50 to 150 knots, an angle of attack range from 0 deg to 10 deg, and a cowl-flap deflection range from 0 deg to 30 deg. The data were analyzed by computing a flow coefficient similar to that used in the analysis of orifices. It was found that all of the flow coefficient values fell within a band that varied linearly with inlet area. The linear mean line through this band provides an estimate of the relationship between cooling-air flow rate and upper plenum pressure over a wide range of test conditions.

(Author)

A81-43149 * # A vortex-lattice method for calculating lifting-surface interference. D. Levin (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1662*. 9 p. 24 refs.

The interference effect of closely coupled lifting surfaces was investigated. A nonsteady vortex-lattice method was applied to calculate the steady-state and nonsteady lift characteristics of configurations having interference effects. The configurations consist of low-aspect-ratio delta wings, at low and high angles of attack. Leading-edge separation and wake roll-up are simulated by a time-dependent wake-shedding procedure. For steady-state flow conditions, this numerical procedure saves a considerable amount of computer time, compared with iterative methods, and yields the same results. A better understanding of the interference effect can be gained by using the method to study the transient behavior. The nonsteady approach also offers the capability of calculating various nonsteady motions, as is demonstrated in the calculation of the longitudinal damping.

(Author)

A81-43151 * # Full-scale wind-tunnel study of wing-fuselage interaction and comparison with paneling method. J. C. Ross, V. R. Corsiglia (NASA, Ames Research Center, Moffett Field, CA), and J. M. Vogel (NASA, Ames Research Center, Moffett Field, CA; Iowa State University of Science and Technology, Ames IA). *American*

Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1666. 10 p. 18 refs.

Full-scale wind-tunnel tests, conducted to determine the effects of three different airfoil sections on the aft-fuselage drag of a low-wing aircraft, are described. The measurements indicate a maximum difference in aft fuselage drag between the three airfoils of about 0.002. Measured changes in the locations of the fuselage pressure contours with airfoil section correlated well with the changes predicted by a three dimensional paneling code. A criterion, based on the inviscid computer code, is then proposed as an indicator for possible adverse viscous interactions at the wing-fuselage juncture. (Author)

A81-44570 * # A vortex-lattice method for calculating longitudinal dynamic stability derivatives of oscillating delta wings. D. Levin (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Atmospheric Flight Mechanics Conference, Albuquerque, NM, Aug. 19-21, 1981, Paper 81-1876*. 11 p. 23 refs.

A nonsteady vortex-lattice method is introduced for predicting the dynamic stability derivatives of a delta wing undergoing an oscillatory motion. The analysis is applied to several types of small oscillations in pitch. The angle of attack varied between + or - 1 deg, with the mean held at 0 deg when the flow was assumed to be attached and between + or - 1 deg and the mean held at 15 deg when both leading-edge separation and wake roll-up were included. The computed results for damping in pitch are compared with several other methods and with experiments, and are found to be consistent and in good agreement. (Author)

A81-44898 * # Numerical and classical analysis of V/STOL aircraft using selected propulsion systems. S. B. Wilson, III, G. H. Kidwell, Jr., and R. S. Christiansen (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1676*. 9 p. 17 refs.

The development needed for the evolution of selected V/STOL research vehicles into optimized antisubmarine warfare (ASW) aircraft configurations, using numerical procedures and traditional analytical methods, has been examined. Three propulsion systems, which represent state-of-the-art development aimed at solving the thrust-vectoring and attitude-control problems of V/STOL aircraft, are analyzed. The use of NASA computer programs for aircraft synthesis (ACSYNT), and for optimizing configurations (COMMIN), coupled with contractor-supplied propulsion system data provides for accurate performance prediction of the selected ASW configurations. Particular emphasis on the transition phase between the research vehicle and the optimized configuration demonstrates the strengths and weaknesses of using generic research aircraft instead of building prototypes to demonstrate new technology. (Author)

A81-46620 * # Full-scale wind-tunnel test of the aeroelastic stability of a bearingless main rotor. W. Warmbrodt, J. McCloud, III (NASA, Ames Research Center, Moffett Field, CA), M. Sheffler, and J. Staley (Boeing Vertol Co., Philadelphia, PA). In: *American Helicopter Society, Annual Forum, 37th, New Orleans, LA, May 17-20, 1981, Proceedings*. (A81-46603 22-01) Washington, DC, American Helicopter Society, 1981, p. 204-216. 12 refs.

The rotor studied in the wind tunnel had previously been flight tested on a BO-105 helicopter. The investigation was conducted to determine the rotor's aeroelastic stability characteristics in hover and at airspeeds up to 143 knots. These characteristics are compared with those obtained from whirl-tower and flight tests and predictions from a digital computer simulation. It was found that the rotor was stable for all conditions tested. At constant tip speed, shaft angle, and airspeed, stability increases with blade collective pitch setting.

No significant change in system damping occurred that was attributable to frequency coalescence between the rotor inplane regressing mode and the support modes. Stability levels determined in the wind

tunnel were of the same magnitude and yielded the same trends as data obtained from whirl-tower and flight tests. G.R.

HELICOPTER SYSTEMS OFFICE

NASA CONTRACTOR REPORTS

N81-10019*# Human Resources Research Organization, Alexandria, Va.
CIVIL HELICOPTER WIRE STRIKE ASSESSMENT STUDY. VOLUME 2: ACCIDENT ANALYSIS BRIEFS Final Report
Clyde H. Tuomela and Mark F. Brennan Oct. 1980 221 p
(Contract NAS2-10505)

(NASA-CR-152390: FR-MTRD(CA)-80-13-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 01C

A description and analysis of each of the 208 civil helicopter wire strike accidents reported to the National Transportation Safety Board (NTSB) for the ten year period 1970-1979 is given. The accident analysis briefs were based on pilot reports, FAA investigation reports, and such accident photographs as were made available. Briefs were grouped by year and, within year, by NTSB accident report number. T.M.

SIMULATION SCIENCES DIVISION

NASA CONTRACTOR REPORTS

N81-23095*# Gjerding (B. K.) Simulation Electronics, Seattle, Wash.
USER'S MANUAL FOR FLIGHT SIMULATOR DISPLAY SYSTEM (FSDS)
Connie C. Egerdahl 18 Nov. 1979 14 p
(Contract NAS2-9434)
(NASA-CR-164295) Avail: NTIS HC A02/MF A01 CSCL

14B

The capabilities of the flight simulator display system (FSDS) are described. FSDS is a color raster scan display generator designed to meet the special needs of Flight Simulation Laboratories. The FSDS can update (revise) the images it generates every 16.6 mS, with limited support from a host processor. This corresponds to the standard TV vertical rate of 60 Hertz, and allows the system to carry out display functions in a time critical environment. Rotation of a complex image in the television raster with minimal hardware is possible with the system. M.G.

V/STOL AIRCRAFT TECHNOLOGY DIVISION

NASA CONTRACTOR REPORTS

X81-10214*# Textron Bell Helicopter, Fort Worth, Tex.
DEVELOPMENT SPECIFICATION FOR A TILT ROTOR AIRCRAFT COMPOSITE BLADE. TILT ROTOR RESEARCH AIRCRAFT
Oct. 1979 44 p
(Contract NAS2-10289)
(NASA-CR-152370: Rept-301-199-017) Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

Specifications for a composite rotor blade for use on the XV-15 tilt rotor aircraft are established. The outlined development specifications include: performance, design, manufacture, airworthiness qualification, and acceptance test requirements.
E.A.K.

X81-10215*# Bell Helicopter Co., Fort Worth, Tex.
ENGINEERING ANALYSIS OF A COMPOSITE ROTOR BLADE FOR THE XV-15 TILT ROTOR AIRCRAFT
Oct. 1979 142 p refs
(Contract NAS2-10289)
(NASA-CR-152368: Rept-301-199-015) Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

A preliminary design study of advanced composite rotor blades for the XV-15 Tilt Rotor Research Aircraft was conducted. A trade-off analysis was performed to select the design concept that best satisfied the following objectives: (1) improve reliability, producibility, and maintainability; (2) minimize manufacturing cost; (3) achieve a fatigue life of at least 3600 hours; (4) increase hover-maneuver thrust capability; and (5) provide redundant blade retention capability. The elected design concept retains the XV-15 hub and rotor controls and is structurally and dynamically compatible with the transmission, wing, and airframe of the XV-15. S.F.

X81-10216*# Bell Helicopter Co., Fort Worth, Tex.
INSPECTION, MAINTENANCE AND REPAIR OF THE COMPOSITE XV-15 ROTOR BLADE: TILT ROTOR RESEARCH AIRCRAFT
Oct. 1979 81 p refs
(Contract NAS2-10289)
(NASA-CR-152369: Rept-301-199-016) Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

The XV-15 tilt rotor aircraft composite rotor blade manufacturing processes and procedures for the fabrication, inspection, maintenance, and repair requirements are discussed. Product assurance functions, design and tooling review, material qualification and control, and inspection requirements during blade manufacturing are presented. The destructive and nondestructive

test requirements for the blade are defined and are used to verify the component location and the strength of the various structural elements of the blade. Inspection and maintenance field operations, blade repair criteria, field repairs, and major repairs and overhaul of the blade at the manufacturer's facilities are presented. A breakwire system is considered applicable. Inspection requirements for major repairs, blade overhaul, blade strikes, sudden rotor stoppage, and foreign object damage are outlined. The blade overhaul possibilities at the manufacturer's facilities are outlined with a brief discussion of each procedure.

E.A.K.

X81-10217*# Bell Helicopter Co., Fort Worth, Tex.
PROGRAM PLAN FOR DEVELOPMENT, FABRICATION, AND QUALIFICATION OF COMPOSITE BLADES FOR THE XV-15 Final Report

Oct. 1979 79 p

(Contract NAS2-10289)

(NASA-CR-152371; Rept-301-199-018) Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

Requirements for the development, fabrication, and qualification of composite rotor blades for the XV-15 aircraft are reported. Increased hover maneuver thrust capability and fatigue life is provided at the minimum manufacturing cost for small lot production with improved reliability and maintainability.

S.F.

X81-10118*# Systems Control, Inc., Palo Alto, Calif.
PRELIMINARY FLIGHT TEST PLANNING FOR XV-15 TILT ROTOR AIRCRAFT Final Report

Aug. 1979 113 p refs

(Contract NAS2-8799)

(NASA-CR-152392) Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

The flight test plan was considered from the viewpoint of flying qualities determination and recommendations made to improve the effectiveness of the tests. Preliminary parameter identification efforts show good results with simple control pulse inputs. The design of optimal control inputs was considered, and recommendations are made of implementable, near-optimal inputs for flight test operations.

T.M.

N81-15981*# Neilsen Engineering and Research, Inc., Mountain View, Calif.

THEORETICAL STUDY OF HULL-ROTOR AERODYNAMIC INTERFERENCE ON SEMIBUOYANT VEHICLES Technical Report, 14 Feb. - 7 Dec. 1977

S. B. Spangler and C. A. Smith Apr. 1978 97 p refs

(Contract NAS2-9512)

(NASA-CR-152127; NEAR-TR-159) Avail: NTIS HC A05/MF A01 CSCL 01A

Analytical methods are developed to predict the pressure distribution and overall loads on the hulls of airships which have close coupled, relatively large and/or high disk loading propulsors for attitude control, station keeping, and partial support of total weight as well as provision of thrust in cruise. The methods comprise a surface-singularity, potential-flow model for the hull and lifting surfaces (such as tails) and a rotor model which calculates the velocity induced by the rotor and its wake at points adjacent to the wake. Use of these two models provides an inviscid pressure distribution on the hull with rotor interference. A boundary layer separation prediction method is used to locate separation on the hull, and a wake pressure is imposed on the separated region for purposes of calculating hull loads. Results

of calculations are shown to illustrate various cases of rotor-hull interference and comparisons with small scale data are made to evaluate the method.

M.G.

N81-17623*# Northwestern Univ., Evanston, Ill.
TRANSPORT JET AIRCRAFT NOISE ABATEMENT IN FOREIGN COUNTRIES: GROWTH, STRUCTURE, IMPACT. VOLUME 1: EUROPE, JULY 1980 Final Report

Frank A. Spencer Jul. 1980 230 p refs

(Grant NsG-2328)

(NASA-CR-152356) Avail: NTIS HC A11/MF A01 CSCL 13B

The development and implementation of aircraft noise control regulations in various European states are described. The countries include the United Kingdom, France, Switzerland, Federal Republic of Germany, Sweden, Denmark, and the Netherlands. Topics discussed include noise monitoring, airport curfews, land use planning, and the government structure for noise regulation.T.M.

N81-17831*# Booz-Allen Applied Research, Inc., Bethesda, Md.
STUDY OF CIVIL MARKETS FOR HEAVY-LIFT AIRSHIPS
 Peter Mettam, Dagfinn Hansen, Charles Chabot, and Robert Byrne
 Dec. 1978 390 p refs

(Contract NAS2-9828)

(NASA-CR-152202) Avail: NTIS HC A17/MF A01 CSCL 12B

The civil markets for heavy lift airships (HLAs) were defined by first identifying areas of most likely application. The operational suitability of HLAs for the applications identified were then assessed. The operating economics of HLAs were established and the market size for HLA services estimated by comparing HLA operating and economic characteristics with those of competing modes. The sensitivities of the market size to HLA characteristics were evaluated and the number and sizes of the vehicles required to service the more promising markets were defined. Important characteristics for future HLAs are discussed that were derived from the study of each application, including operational requirements, features enhancing profitability, military compatibility, improved design requirements, approach to entry into service, and institutional implications for design and operation.

T.M.

N81-19088*# Aerophysics Research Corp., Bellevue, Wash.
GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 1: MAIN PROGRAM. PART 1: THEORETICAL DEVELOPMENT

D. Hague Jan. 1978 197 p refs 6 Vol.

(Contract NAS2-9352)

(NASA-CR-152303-Vol-1-Pt-1)

Avail: NTIS

HC A09/MF A01 CSCL 01C

The General Aviation synthesis program performs tasks generally associated with aircraft preliminary design and allows an analyst the capability of performing parametric studies in a rapid manner. GASP emphasizes small fixed-wing aircraft employing propulsion systems varying from a single piston engine with fixed pitch propeller through twin turboprop/turboprop powered business or transport type aircraft. The program, which may be operated from a computer terminal in either the batch or interactive graphic mode, is comprised of modules representing the various technical disciplines integrated into a computational flow which ensures that the interacting effects of design variables are continuously accounted for in the aircraft sizing procedure. The model is a useful tool for comparing configurations, assessing aircraft performance and economics, performing tradeoff and sensitivity studies, and assessing the impact of advanced technologies on aircraft performance and economics.

A.R.H.

N81-19089*# Aerophysics Research Corp., Bellevue, Wash.
GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 2: GEOMETRY. PART 1: THEORETICAL DEVELOPMENT

D. Hague Jan. 1978 26 p refs 6 Vol.

(Contract NAS2-9352)

(NASA-CR-152303-Vol-2-Pt-1)

HC A03/MF A01 CSCL 01C

Avail: NTIS

The gross characteristics of an aircraft under study are specified to the subroutines SIZE. The principal quantities specified are both geometric (lengths and areas) and operational (altitude and Mach number). The sequence of computations carried out by SIZE is controlled by the parameter NPC which is passed into SIZE by COMMON. When NPC=0, the computation is initialized. Subsequently, NPC is set to 2 and the program advances through the geometric computations. Geometry models for the fuselage, wing, empennage, cabin pressurization, and nacelle area are examined.

A.R.H.

N81-19090*# Aerophysics Research Corp., Bellevue, Wash. GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 3: AERODYNAMICS. PART 1: THEORETICAL DEVELOPMENT

D. Hague Jan. 1978 103 p refs 6 Vol.

(Contract NAS2-9352)

(NASA-CR-152303-Vol-3-Pt-1)

HC A06/MF A01 CSCL 01C

Avail: NTIS

Aerodynamics calculations are treated in routines which concern moments as they vary with flight conditions and attitude. The subroutines discussed: (1) compute component equivalent flat plate and wetted areas and profile drag; (2) print and plot low and high speed drag polars; (3) determine lift coefficient or angle of attack; (4) determine drag coefficient; (5) determine maximum lift coefficient and drag increment for various flap types and flap settings; and (6) determine required lift coefficient and drag coefficient in cruise flight.

A.R.H.

F

N81-19091*# Aerophysics Research Corp., Bellevue, Wash. GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 4: PROPULSION. PART 1: THEORETICAL DEVELOPMENT

D. Hague Jan. 1978 191 p refs 6 Vol.

(Contract NAS2-9352)

(NASA-CR-152303-Vol-4-Pt-1)

HC A09/MF A01 CSCL 01C

Avail: NTIS

Propulsion system performance is computed during engine sizing and whenever aircraft performance is computed. The propulsion model user's and programmer's manual is presented. Routines are provided for jet and propeller driven aircraft. A.R.H.

N81-19092*# Aerophysics Research Corp., Bellevue, Wash. GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 5: WEIGHTS. PART 1: THEORETICAL DEVELOPMENT

D. Hague Jan. 1978 151 p refs 6 Vol.

(Contract NAS2-9352)

(NASA-CR-152303-Vol-5-Pt-1)

HC A08/MF A01 CSCL 01C

Avail: NTIS

Subroutines for determining the weights of propulsion system related components and the airframe components of an aircraft configuration are presented. Subroutines that deal with design load conditions, aircraft balance, and tail sizing are included. Options for turbine and internal combustion engines are provided.

A.R.H.

N81-19093*# Aerophysics Research Corp., Bellevue, Wash. GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 6: PERFORMANCE. PART 1: THEORETICAL DEVELOPMENT

D. Hague Jan. 1978 121 p refs 6 Vol.

(Contract NAS2-9352)

(NASA-CR-152303-Vol-6-Pt-1)

Avail: NTIS

HC A08/MF A01 CSCL 01C

Aircraft performance modeling requires consideration of propulsion, aerodynamics, and weight characteristics. Eleven subroutines used in modeling aircraft performance are presented and their interactions considered. Manuals for performance model users and programmers are included.

A.R.H.

N81-19094*# Aerophysics Research Corp., Bellevue, Wash. GASP- GENERAL AVIATION SYNTHESIS PROGRAM. VOLUME 7: ECONOMICS. PART 1: THEORETICAL DEVELOPMENT

Jan. 1978 39 p refs

(Contract NAS2-9352)

(NASA-CR-152303-Vol-7-Pt-1)

HC A03/MF A01 CSCL 01C

Avail: NTIS

The economic analysis includes: manufacturing costs; labor costs; parts costs; operating costs; markups and consumer price. A user's manual for a computer program to calculate the final consumer price is included.

S.F.

N81-23064*# Boeing Vertol Co., Philadelphia, Pa. PRELIMINARY DESIGN STUDY OF ADVANCED COMPOSITE BLADE AND HUB AND NONMECHANICAL CONTROL SYSTEM FOR THE TILT-ROTOR AIRCRAFT. VOLUME 1: ENGINEERING STUDIES Final Report

H. R. Alexander, K. E. Smith, M. A. McVeigh, P. G. Dixon, and B. L. McManus Nov. 1979 263 p refs 2 Vol.

(Contract NAS2-10160)

(NASA-CR-152336-1: D210-11569-1-Vol-1)

HC A12/MF A01 CSCL 01C

Avail: NTIS

Composite structures technology is applied in a preliminary design study of advanced technology blades and hubs for the XV-15 tilt rotor research demonstrator aircraft. Significant improvements in XV-15 hover and cruise performance are available using blades designed for compatibility with the existing aircraft, i.e., blade installation would not require modification of the airframe, hub or upper controls. Provision of a low risk nonmechanical control system was also studied, and a development specification is given.

Author

N81-23065*# Boeing Vertol Co., Philadelphia, Pa. PRELIMINARY DESIGN STUDY OF ADVANCED COMPOSITE BLADE AND HUB AND NONMECHANICAL CONTROL SYSTEM FOR THE TILT-ROTOR AIRCRAFT. VOLUME 2: PROJECT PLANNING DATA

Feb. 1980 65 p refs 2 Vol.

(Contract NAS2-10160)

(NASA-CR-152336-2: D210-11569-2-Vol-2)

HC A04/MF A01 CSCL 01C

Avail: NTIS

Project planning data for a rotor and control system procurement and testing program for modifications to the XV-15 tilt-rotor research demonstrator aircraft is presented. The design, fabrication, and installation of advanced composite blades compatible with the existing hub, an advanced composite hub, and a nonmechanical control system are required.

J.D.H.

N81-33190*# Beech Aircraft Corp., Wichita, Kans. APPLICATION OF ADVANCED TECHNOLOGIES TO DERIVATIVES OF CURRENT SMALL TRANSPORT AIRCRAFT Final Report

P. P. Renze and J. E. Terry Jul. 1981 112 p refs

(Contract NAS2-10571)

(NASA-CR-166197) Avail: NTIS HC A06/MF A01 CSCL 01C

Mission requirements of the derivative design were the same as the baseline to readily identify the advanced technology benefits achieved. Advanced technologies investigated were in the areas of propulsion, structures and aerodynamics and a direct operating cost benefit analysis conducted to identify the most promising.

Engine improvements appear most promising and combined with propeller, airfoil, surface coating and composite advanced technologies give a 21-25 percent DOC savings. A 17 percent

higher acquisition cost is offset by a 34 percent savings in fuel used.
T.M.

V/STOL PROJECTS OFFICE

NASA CONTRACTOR REPORTS

**X81-10001*# Boeing Commercial Airplane Co., Seattle, Wash.
LARGE SCALE WIND TUNNEL INVESTIGATION FOR
FUTURE MODIFICATIONS TO THE QUIET SHORT-HAUL
RESEARCH AIRCRAFT Final Report**

Donald N. Hultman Sep. 1980 128 p refs

(Contract NAS2-9196)

(NASA-CR-152349; D340-1-1-3)

Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

Results are presented of an investigation to eliminate the leading-edge blowing system on the baseline quiet short-haul research aircraft (QSRA.) This was accomplished by repositioning the leading-edge flaps to a slotted position. Gap, overlap, and deflection angle variations were investigated. A configuration was established that satisfies QSRA performance and safety margin requirements
T.M.

**X81-10002*# Boeing Commercial Airplane Co., Seattle, Wash.
USB PROPULSIVE-LIFT AIRCRAFT DESIGN AND
PERFORMANCE STUDY Interim Report**

Stanley Youth Nov. 1980 137 p refs

(Contract NAS2-9081)

(NASA-CR-152387; D340-10108)

Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

The operational characteristics and performance were evaluated for two types of airplanes configured to use quiet short-haul research aircraft upper surface blown power lift technology. These aircraft, the short field commercial transport, and medium sized business jet, were designed for short field operation at approximately 500 nmi range. The assessment of community noise was included as well as an economic analysis of short-haul transport.
R.C.T.

**X81-10003*# Boeing Commercial Airplane Co., Seattle, Wash.
ANALYSIS OF CONTRACTOR'S TAXI AND FLIGHT TEST
OF THE QSRA**

Oct. 1980 253 p refs

(Contract NAS2-9081)

(NASA-CR-152322; D340-13805)

Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

Taxi and flight testing of the quiet short-haul aircraft (QSHRA) was conducted. The basic airworthiness of the airplane was verified including structural integrity and systems operation and evaluation. A preliminary evaluation was made of the airplane's capability to carry out the intended research missions. The QSRA was found to be airworthy and capable of carrying out its research vehicle role.
R.C.T.

F

OFFICE OF THE DIRECTOR OF ASTRONAUTICS

NO PUBLICATIONS

AIRBORNE MISSIONS AND APPLICATIONS DIVISION

NASA FORMAL REPORTS

N81-21440*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WESTERN REGIONAL REMOTE SENSING CONFERENCE PROCEEDINGS, 1979

1980 192 p Conf. held at Naval Postgraduate School, Monterey, Calif., 17 - 19 Oct. 1979
(NASA-CP-2148; Rept-A-8320) Avail: NTIS HC A09/MF A01 CSCL 05A

Remote sensing users from the 14 western states explained their diverse applications of LANDSAT data, discussed operational goals, and exchanged problems and solutions. In addition, conference participants stressed the need for increased cooperation among state and local governments, private industry, and universities to aid NASA's objective of transferring to user agencies the ability to operationally use remote sensing technology for resource and environmental quality management. A.R.H.

NASA TECHNICAL MEMORANDA

N81-22450*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STATEWIDE LANDSAT INVENTORY OF CALIFORNIA FORESTS

William Likens and David Peterson, Principal Investigators Feb. 1981 28 p refs ERTS
(E81-10134; NASA-TM-81255; A-8445) Avail: NTIS HC A03/MF A01 CSCL 02F

Six forest cover categories were mapped, along with 10 general land cover classes. To map the state's 100 million acres, 1.6 acre mapping units were utilized. Map products were created. Standing forest acreage for the state was computed to be 26.8 million acres. T.M.

NASA CONTRACTOR REPORTS

N81-14531*# San Jose State Univ., Calif.
ONE-DIMENSIONAL SIMULATION OF TEMPERATURE AND MOISTURE IN ATMOSPHERIC AND SOIL BOUNDARY LAYERS Final Report

Robert D. Bornstein and Krishnamurthy Santhanam (Informatics, Inc., Palo Alto, Calif.) Jan. 1981 6 p refs
(Grant NSG-2184)
(NASA-CR-163841) Avail: NTIS HC A02/MF A01 CSCL 04A

Meteorologists are interested in modeling the vertical flow of heat and moisture through the soil in order to better simulate the vertical and temporal variations of the atmospheric boundary

layer. The one dimensional planetary boundary layer model of is modified by the addition of transport equations to be solved by a finite difference technique to predict soil moisture. Author

N81-15035*# San Jose State Univ., Calif. Dept. of Chemistry.

SOME ASPECTS OF ANALYTICAL CHEMISTRY AS APPLIED TO WATER QUALITY ASSURANCE TECHNIQUES FOR RECLAIMED WATER: THE POTENTIAL USE OF X-RAY FLUORESCENCE SPECTROMETRY FOR AUTOMATED ON-LINE FAST REAL-TIME SIMULTANEOUS MULTI-COMPONENT ANALYSIS OF INORGANIC POLLUTANTS IN RECLAIMED WATER Final Report, Jan. 1978 - Sep. 1980
Alan Campbell Ling, Lloyd H. MacPherson, and Maria Rey 10 Jan. 1981 135 p
(Grant NSG-2305)

(NASA-CR-163847) Avail: NTIS HC A07/MF A01 CSCL 07D

The potential use of isotopically excited energy dispersive X-ray fluorescence (XRF) spectrometry for automated on line fast real time (5 to 15 minutes) simultaneous multicomponent (up to 20) trace (1 to 10 parts per billion) analysis of inorganic pollutants in reclaimed water was examined. Three anionic elements (chromium 6, arsenic and selenium) were studied. The inherent lack of sensitivity of XRF spectrometry for these elements mandates use of a preconcentration technique and various methods were examined, including: several direct and indirect evaporation methods; ion exchange membranes; selective and nonselective precipitation; and complexation processes. It is shown the XRF spectrometry itself is well suited for automated on line quality assurance, and can provide a nondestructive (and thus sample storage and repeat analysis capabilities) and particularly convenient analytical method. Further, the use of an isotopically excited energy dispersive unit (50 mCi Cd-109 source) coupled with a suitable preconcentration process can provide sufficient sensitivity to achieve the current mandated minimum levels of detection without the need for high power X-ray generating tubes. DOE

N81-19364*# Ford Aerospace and Communications Corp., Palo Alto, Calif. Western Development Labs. Div.

A STUDY AND EXPERIMENT PLAN FOR DIGITAL MOBILE COMMUNICATION VIA SATELLITE Final Report

J. J. Jones, E. J. Craighill, R. G. Evans, A. D. Vincze, and N. N. Tom 30 Nov. 1978 165 p refs
(Contract NAS2-9936)
(NASA-CR-152213; WDL-TR7957) Avail: NTIS HC A08/MF A01 CSCL 17B

The viability of mobile communications is examined within the context of a frequency division multiple access, single channel per carrier satellite system emphasizing digital techniques to serve a large population of users. The intent is to provide the mobile users with a grade of service consistent with the requirements for remote, rural (perhaps emergency) voice communications, but which approaches toll quality speech. A traffic model is derived

on which to base the determination of the required maximum number of satellite channels to provide the anticipated level of service. Various voice digitalization and digital modulation schemes are reviewed along with a general link analysis of the mobile system. Demand assignment multiple access considerations and analysis tradeoffs are presented. Finally, a completed configuration is described. M.G.

N81-19478* # McDonnell-Douglas Astronautics Co., St. Louis, Mo.

OUTER PLANET PROBE ENGINEERING MODEL STRUCTURAL TESTS

J. A. Smittkamp, W. H. Gustin, and M. W. Griffin Sep. 1977 159 p refs

(Contract NAS2-9027)

(NASA-CR-152036) Avail: NTIS HC A08/MF A01 CSCL 20K

A series of proof of concept structural tests was performed on an engineering model of the Outer Planets Atmospheric Entry Probe. The tests consisted of pyrotechnic shock, dynamic and static loadings. The tests partially verified the structural concept. Author

N81-19792* # TRW Defense and Space Systems Group, Redondo Beach, Calif.

STUDY OF ADAPTIVE METHODS FOR DATA COMPRESSION OF SCANNER DATA

Mar. 1977 153 p refs

(Contract NAS2-8394)

(NASA-CR-152007; TRW-26566) Avail: NTIS HC A07/MF A01 CSCL 09B

The performance of adaptive image compression techniques and the applicability of a variety of techniques to the various steps in the data dissemination process are examined in depth. It is concluded that the bandwidth of imagery generated by scanners can be reduced without introducing significant degradation such that the data can be transmitted over an S-band channel. This corresponds to a compression ratio equivalent to 1.84 bits per pixel. It is also shown that this can be achieved using at least two fairly simple techniques with weight-power requirements well within the constraints of the LANDSAT-D satellite. These are the adaptive 2D DPCM and adaptive hybrid techniques. M.G.

N81-20063* # ECON, Inc., San Jose, Calif.

STUDY OF MATERIALS PERFORMANCE MODEL FOR AIRCRAFT INTERIORS Final Report

K. Leary and J. Skratz 31 Aug. 1980 86 p

(Contract NAS2-10515)

(NASA-CR-152378) Avail: NTIS HC A05/MF A01 CSCL 01C

A demonstration version of an aircraft interior materials computer data library was developed and contains information on selected materials applicable to aircraft seats and wall panels, including materials for the following: panel face sheets, bond plies, honeycomb, foam, decorative film systems, seat cushions, adhesives, cushion reinforcements, fire blocking layers, slipcovers, decorative fabrics and thermoplastic parts. The information obtained for each material pertains to the material's performance in a fire scenario, selected material properties and several measures of processability. T.M.

N81-23547* # Kansas Univ., Lawrence. Space Technology Center.

CROP PHENOLOGY AND LANDSAT-BASED IRRIGATED LANDS INVENTORY IN THE HIGH PLAINS Interim Report, 1 Sep. - 30 Nov. 1980

E. A. Martinko, Principal Investigator, J. Poracsky, E. R. Kipp, and H. Krieger 30 Nov. 1980 34 p ERTS

(Grant NAG2-57)

(E81-10138; NASA-CR-164146; IR-1) Avail: NTIS HC A03/MF A01 CSCL 02C

The activity concentrated on identifying crop and irrigation data sources for the eight states within the High Plains Aquifer and making contacts concerning the nature of these data. A mail questionnaire was developed to gather specific data not routinely reported through standard data collection channels. Input/output routines were designed for High Plains crop and irrigation data and initial statistical data on crops were input to computer files. T.M.

N81-23553* # California Univ., Berkeley.

REMOTE SENSING OF WATER QUALITY IN RESERVOIRS AND LAKES IN SEMI-ARID CLIMATES Final Report

Harold M. Anderson and Alexander J. Horne Dec. 1975 143 p refs

(Grant NSG-2003)

(NASA-CR-166178; SERL-75-1) Avail: NTIS HC A07/MF A01 CSCL 08H

Overlake measurements using aerial cameras (remote sensing) combined with water truth collected from boats most economically provided wide-band photographs rather than precise spectra. With use of false color infrared film (400-950 nm), the reflected spectral signatures seen from hundreds to thousands of meters above the lake merged to produce various color tones. Such colors were easily and inexpensively obtained and could be recognized by lake management personnel without any prior training. The characteristic spectral signatures of various algal types were also recognizable in part by the color tone produced by remote sensing. T.M.

N81-25453* # Humboldt State Univ., Arcata, Calif. Dept. of Forestry.

THE APPLICATION OF LANDSAT REMOTE SENSING TECHNOLOGY TO NATURAL RESOURCES MANAGEMENT. SECTION 1: INTRODUCTION TO VICAR - IMAGE CLASSIFICATION MODULE. SECTION 2: FOREST RESOURCE ASSESSMENT OF HUMBOLDT COUNTY. Final Report, Apr. - Dec. 1980

Lawrence Fox, III, Principal Investigator and Kenneth E. Mayer Dec. 1980 39 p refs ERTS

(Grant NSG-2341)

(E81-10120; NASA-CR-164114) Avail: NTIS HC A03/MF A01 CSCL 05B

A teaching module on image classification procedures using the VICAR computer software package was developed to optimize the training benefits for users of the VICAR programs. The field test of the module is discussed. An intensive forest land inventory strategy was developed for Humboldt County. The results indicate that LANDSAT data can be computer classified to yield site specific forest resource information with high accuracy (82%). The 'Douglas-fir > 80%' category was found to cover approximately 21% of the county and 'Mixed Conifer > 80%' covering about 13%. The 'Redwood > 80%' resource category, which represented dense old growth trees as well as large second growth, comprised 4.0% of the total vegetation mosaic. Furthermore, the 'Brush' and 'Brush-Regeneration' categories were found to be a significant part of the vegetative community, with area estimates of 9.4 and 10.0%. E.D.K.

N81-28419* # Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.

PROTOTYPE Ge:Ga DETECTORS FOR THE NASA-AMES COOLED GRATING SPECTROMETER Final Technical Report, 1 May 1980 - 31 Jan. 1981

J. R. Houck Jul. 1981 12 p

(Contract NCC2-79)

(NASA-CR-164639) Avail: NTIS HC A02/MF A01 CSCL 14B

The detectors were fabricated from a Ge:Ga wafer from Eagle-Pitcher with a room temperature resistivity of approx.

12 ohms cm. The wafer is approximately 2 inches in diameter and 0.061 inches thick. The contact material was ion implanted with Boron using 10 to the 14th power ions/sq cm at 25 keV and 2 x10 to the 14th power ions/sq cm at 50 keV. The crystal was then sputter-cleaned and metallized first with sputtered Ti and then sputter Au. In addition to the usual infrared measurements of responsivity and noise, measurements were made of the detectors' response to ionizing radiation. T.M.

N81-33117* Cornell Univ., Ithaca, N. Y. Dept. of Astronomy.
MOLECULAR HYDROGEN EMISSION FROM W51
Steven Beckwith and Ben Zuckerman (Maryland Univ.) Sep. 1981 17 p refs
(Grants NSG-2412; NSF AST-76-17600)
(NASA-CR-164608; CRSR-775) Avail: NTIS
HC A02/MF A01 CSCL 03B

The detection of emission from the $v = 1$ approaches 0 S(1) quadrupole transition of H₂ toward the cluster of intense infrared and H₂O maser sources in W51 (north) is reported. The apparent luminosity of this line in W51 (north) is only about 4% of the luminosity of the same line toward the Kleinmann-Low infrared cluster in Orion; however, additional line-of-sight extinction and spatial extent of the source may account for the lower apparent power in W51. Similarity in the infrared and H₂O properties of these clusters is addressed. The implications of the H₂ emission for mass loss in the W51 region is discussed and some proposed models of radiation-driven mass outflow from pre-main sequence stars are briefly considered. M.G.

N81-33558*# Kansas Univ., Lawrence. Space Technology Center.

CROP PHENOLOGY AND LANDSAT-BASED IRRIGATED LANDS INVENTORY IN THE HIGH PLAINS: APPENDICES Final Report

[1981] 201 p refs ERTS
(Grant NAG2-57)
(E81-10172; NASA-CR-164565) Avail: NTIS
HC A10/MF A01 CSCL 02C

Data collected in an effort to produce a master crop calendar in map and tabular format for the High Plains Aquifer are presented. Contents include: a key to the counties in the High Plains Aquifer; USDA Economics and Statistic Service data for 1979; Agricultural Stabilization and Conservation Service data for 1979 and 1980; Cooperative Extension Service data for 1979 and 1980; recording methods from questionnaire; scatterplots portraying ASCS, Extension and ESS data; crop irrigation maps; and weekly summary based optimal LANDSAT dates. A bibliography is included. A.R.H.

N81-33559*# Kansas Univ., Lawrence. Space Technology Center.

CROP PHENOLOGY AND LANDSAT-BASED IRRIGATED LANDS INVENTORY IN THE HIGH PLAINS Final Report

E. A. Martinko, Principal Investigator, J. Poracsky, E. R. Kipp, H. Krieger, and K. Gunn [1981] 139 p ERTS
(Grant NAG2-57)
(E81-10173; NASA-CR-164566) Avail: NTIS
HC A07/MF A01 CSCL 02C

The need to determine the volume of ground water being pumped from the High Plains region aquifer (HPRA) for irrigation can be met using a LANDSAT based remote sensing system. Crop calendar differences in such a large area (most of Nebraska, half of Kansas, the Texas and Oklahoma Panhandle areas, a portion of South Dakota, and the eastern parts of Wyoming, Colorado, and New Mexico) can introduce local influences on the interpretation of the algorithms employed. A method is described for determining the optimal dates for inventorying various crops grown on these irrigated lands in support of an effort to identify irrigated and develop a computer model for predicting aquifer response to changes in ground water development. A crop calendar for the crops grown in the HPRA is presented. A.R.H.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-11135 * Far-infrared polarization of the Kleinmann-Low Nebula. G. E. Gull, R. W. Russell, G. Melnick, and M. Harwit (Cornell University, Ithaca, N.Y.). *Astronomical Journal*, vol. 85, Oct. 1980, p. 1379-1381. 10 refs. Grants No. NGR-05-005-055; No. NSG-2262; No. NSG-2347.

Further data on the polarization of the far-infrared (wavelength greater than 40 microns) emission from the Orion Nebula shows no evidence for polarized emission by aligned grains. Results at wavelength about 71-115 microns are consistent with a small (about 1.5%) absorption-induced polarization with about the same position angle on the sky as the polarization measured at shorter wavelengths. (Author)

A81-12843 * Detection of the 157 micron /1910 GHz/ /C II/ emission line from the interstellar gas complexes NGC 2024 and M42. R. W. Russell, G. Melnick, G. E. Gull, and M. Harwit (Cornell University, Ithaca, N.Y.). *Astrophysical Journal, Part 2 - Letters to the Editor*, vol. 240, Sept. 1, 1980, p. L99-L103. 28 refs. Grant No. NGR-33-010-146.

A81-18521 * Star formation in IC 1848 A. H. A. Thronson, Jr., P. M. Harvey, A. T. Tokunaga (Steward Observatory, Tucson, Ariz.), R. I. Thompson (Steward Observatory; Arizona, University, Tucson, Ariz.), and L. J. Rickard (National Radio Astronomy Observatory, Charlottesville, Va.). *Astrophysical Journal, Part 1*, vol. 242, Dec. 1, 1980, p. 609-614. 32 refs. NSF Grant No. AST-78-20393; Grant No. NGR-03-002-390.

Recent far-infrared photometric and near-infrared spectroscopic observations of IC 1848 A/W5 East are reported. The source appears to be excited by a star of spectral type near B0, which can explain the far-infrared luminosity, 2 micron spectrum, radio continuum, and radio molecular observations. Although this star appears surrounded by a local very compact H II region, the density over a large scale is relatively low. This puts constraints on models for the formation of this star. (Author)

A81-18544 * Medium-resolution spectra of M82 and NGC 1068 from 16 to 30 microns. J. R. Houck, W. J. Forrest, and J. F. McCarthy (Cornell University, Ithaca, N.Y.). *Astrophysical Journal, Part 2 - Letters to the Editor*, vol. 242, Dec. 1, 1980, p. L65-L68. 26 refs. Grant No. NGR-33-010-081.

A81-22075 * Experimental relations between airborne and ground measured wheat canopy temperatures. J. P. Millard (NASA, Ames Research Center, Moffett Field, Calif.) R. J. Reginato, S. B. Idso, R. D. Jackson (Science and Education Administration, Phoenix, Ariz.), R. C. Goettelman (LFE Corp., Richmond, Calif.), and M. J. LeRoy (DCA Corp., Palo Alto, Calif.). *Photogrammetric Engineering and Remote Sensing*, vol. 46, Feb. 1980, p. 221-224. 11 refs.

Experiments using ground-based measurements of canopy temperatures have shown that plant temperatures are good indicators of plant water stress, and thus are useful for assessing water requirements and predicting yields. An intensive 23-day airborne- and ground-measurement program was conducted in Phoenix, Arizona in 1977 to compare airborne-acquired wheat canopy temperatures with simultaneous ground measurements. For canopies that covered at least 85 percent of the soil surface, airborne measurements differed from ground measurements of plant temperature by less than 2 C.

Regardless of the amount of plant cover, the airborne measurements were virtually identical to ground-nadir measurements, and thus represent a combination of plant temperature and solid background temperature. (Author)

A81-22786 * The luminosity functions of the 1969 Perseid and Orionid meteor showers. K. Krisciunas (NASA, Ames Research Center, Moffett Field, Calif.). *Icarus*, vol. 43, Sept. 1980, p. 381-384. 8 refs.

Observations of the 1969 Perseid and Orionid meteor showers are presented and used to derive luminosity functions for the 288 Perseids and 56 Orionids detected. Visual counts were performed under very good to excellent seeing conditions at the times of peak activities, and the brightnesses of the meteors were estimated to the nearest magnitude by comparison with the magnitudes of known objects. Maximum likelihood estimates of the power law index of the luminosity function of 1.56 $\pm$ 0.06 for the Perseids and of 1.85 $\pm$ 0.1 for the Orionids are obtained which are lower than the values found by other investigators. Under the assumption that the luminosity of visual meteors is proportional to their mass, the luminosity function power law may also be used to characterize the mass function. A.L.W.

A81-45432 * Infrared-temperature variability in a large agricultural field. J. P. Millard (NASA, Ames Research Center, Moffett Field, CA), R. C. Goettelman (EAL Corp., Richmond, CA), and M. J. LeRoy (DCA Corp., Palo Alto, CA). *International Journal of Remote Sensing*, vol. 2, July-Sept. 1981, p. 201-211.

Dunnigan Agro-Meteorological Experiment airborne thermal scanner images of a large varying-terrain barley field are acquired and analyzed. Temperature variability that may occur within instantaneous fields of view (IFOV) is defined (coefficient of variation: standard deviation/mean temperature in degrees C), and the percentage of the area within various IFOV's within $\pm$ 1, 2, 3, and 5 degrees of the mean is determined. With the exception of very rugged terrain, over 80% of the area within 4, 16, 65 and 258 ha cells was at temperatures within $\pm$ 3 C of the mean cell temperature. Remote measurements of field temperature appeared to be slightly influenced by pixel size in the range 4 ha to 259 ha, and the area percentage within any pixel which contributes within $\pm$ 1, 2, 3, and 5 degrees C of the mean, is nominally the same. In conclusion, no great advantage is found in utilizing a small IFOV instead of a large one for remote sensing of crop temperature. D.L.G.

CONFERENCE AND MEETING PAPERS

N81-19041*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A METHOD FOR DETERMINING LANDING RUNWAY LENGTH FOR A STOL AIRCRAFT

D. M. Watson, G. H. Hardy, J. F. Moran, and D. N. Warner, Jr. In NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 127-144 refs (For primary document see N81-19035 10-03)
Avail: NTIS HC A17/MF A01 CSCL 01C

Based on data obtained from flight tests of the augmentor wing jet STOL research aircraft, a method is proposed for determining the length of the landing runway for powered-lift STOL aircraft. The suggested method determines runway landing length by summing three segments: the touchdown-dispersion distance, the transition distance from touchdown to application of brakes, and the stopping distance after brakes are applied. It is shown how the landing field length can be reduced either through improved autoland system design or by providing the pilot with appropriate information to allow him to identify a 'low probability' long or short landing and to execute a go-around.

The proposed method appears to determine a safe runway landing length for the STOL application and offers the potential for reducing runway length if great emphasis is placed on a short-runway capability. FAR Parts 25 and 121 appear conservative and suitable for the situation where no great emphasis is placed on reducing the runway length requirement. A.R.H.

N81-19050*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE 1979 CLEAR AIR TURBULENCE FLIGHT TEST PROGRAM

E. A. Weaver, L. J. Ehernberger, B. L. Gary, R. L. Kurkowski, P. M. Kuhn (NOAA), and L. P. Stearns (NOAA) In NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 293-311 refs Prepared in cooperation with JPL, California Inst. of Tech., Pasadena and Ames Research Center (For primary document see N81-19035 10-03)
Avail: NTIS HC A17/MF A01 CSCL 01C

The flight experiments for clear air turbulence (CAT) detection and measurement concepts are described. The test were conducted over the western part of the United States during the winter season of 1979 aboard NASA's Galileo 2 flying laboratory. A carbon dioxide pulsed Doppler lidar and an infrared radiometer were tested for the remote detection and measurement of CAT. Two microwave radiometers were evaluated for their ability to provide encounter warning and altitude avoidance information. M.G.

N81-19517*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SNOW ELECTROMAGNETIC MEASUREMENTS

William I Linor, James L. Smith (U.S. Forest Service Berkeley, Calif.), Fred D. Clapp (California Univ., Berkeley), and Diogenes J. Angelakos (California Univ., Berkeley.) In NASA. Goddard Space Flight Center Microwave Remote Sensing of Snowpack Properties 1980 p 93-117 refs (For primary document see N81-19511 10-43)
(Contract NCA2-0R050-704)

Avail: NTIS HC A12/MF A01 CSCL 08L

An electromagnetic system is described for measuring the dielectric constant and attenuation of snow samples in the frequency range of 4 to 12 GHz. System components consists of a swept-frequency source, microwave horns, network analyzer, and XY plotter. The procedure for calibrating the effect of wetness on the snow properties is described. Equations are given that express the experimentally determined relation between attenuation per unit length and volume percent wetness at any frequency between 4 and 12 GHz. permittivity can be calculated from the snow density, attenuation per unit length, and frequency. Some applications of the techniques are described such as runoff forecasting from mountain snowpacks. E.D.K.

A81-23637 * # Spatial variability of surface temperature as related to cropping practice with implications for irrigation management. J. L. Hatfield (California, University, Davis, Calif.), J. P. Millard (NASA, Ames Research Center, Moffett Field, Calif.), R. J. Reginato, R. D. Jackson, S. B. Idso, P. J. Pinter, Jr. (U.S. Department of Agriculture, Water Conservation Laboratory, Phoenix, Ariz.), and R. C. Goettelman (LFE Corp., Palo Alto, Calif.). In: International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings. Volume 3. (A81-23532 09-43) Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p. 1311-1320. 11 refs.

Crop stress measured using thermal infrared emission is evaluated with the stress-degree-day (SDD) concept. Throughout the season, the accumulation of SDD during the reproductive stage of growth is inversely related to yield. This relationship is shown for durum wheat, hard red winter wheat, barley, grain sorghum and soybeans. It is noted that SDD can be used to schedule irrigations for

maximizing yields and for applying remotely sensed data to management of water resources. An airborne flight with a thermal-IR scanner was used to examine the variability in temperature that may exist from one field to another and to determine realistic within-field temperature variations. It was found that the airborne and the ground-based data agreed very well and that there was less variability in the fields that were completely covered with crops than those of bare soil. L.S.

A81-37220 * Kuiper Airborne Observatory /Space Science Platform 1/. C. M. Gillespie, Jr. (NASA, Ames Research Center, Medium Altitude Missions Branch, Moffett Field, Calif.). In: Shuttle pointing of electro-optical experiments; Proceedings of the Seminar, Los Angeles, Calif., February 10-13, 1981. (A81-37219 16-19) Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1981, p. 1-7. 13 refs.

It is pointed out that jet transport aircraft operating in the stratosphere (often at 45,000 ft) have proved highly cost-effective and convenient as telescope platforms. The Kuiper Airborne Observatory (KAO) 91-cm telescope is described, with attention given to specifications, pointing and tracking, data handling, instrument development, and costs. It is noted that the observatory makes possible important astronomical research, graduate-level instruction, and the development and testing of rugged, remotely controlled instruments. Contributions made by the KAO to planetary astronomy, extragalactic astronomy, the interstellar medium, and to the study of star formation and evolution are enumerated. C.R.

A81-45879 * Atmospheric correction of Nimbus-7 Coastal Zone Color Scanner imagery. H. R. Gordon (Miami, University, Coral Gables, FL), J. L. Mueller (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, MD), and R. C. Wrigley (NASA, Ames Research Center, Moffett Field, CA). In: Remote sensing of atmospheres and oceans; Proceedings of the Interactive Workshop on Interpretation of Remotely Sensed Data, Williamsburg, VA, May 23-25, 1979. (A81-45861 22-46) New York, Academic Press, Inc., 1980, p. 457-481; Discussion, p. 482, 483. 11 refs. Contract No. NAS5-22963.

The Coastal Zone Color Scanner (CZCS) on Nimbus-7 is a scanning radiometer designed to view the ocean in six spectral bands (centered at 443, 520, 550, 670, 750, and 11,500 nm) for the purpose of estimating sea surface chlorophyll and temperature distributions. In the visible bands, the atmosphere obscures the

imagery to the extent that at 443 nm, at most, only 20 percent of the observed radiance originates from beneath the sea surface. Retrieving this subsurface radiance from the imagery is complicated by the highly variable nature of the aerosol's contribution. In this paper, an algorithm for the removal of these atmospheric effects from CZCS imagery is described, a preliminary application of the algorithm to an image with very strong horizontal variations in the aerosol optical thickness is presented, and retrieval of the spatial distribution of the aerosol optical thickness is discussed. (Author)

A81-46054 * # Bulk processing techniques for very large areas - Landsat classification of California. W. Newland (Technicolor Graphic Services, Inc., Moffett Field, CA), D. Peterson, and S. Norman (NASA, Ames Research Center, Moffett Field, CA). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. (A81-46026 22-43) New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 306-318. 6 refs.

In 1977, California Law AB452 was passed to provide a mandate for the California Department of Forestry (CDF) to design and implement an information system to assess the forest land base for multiple uses and values. In connection with this mandate, a land-cover map of the entire state, emphasizing forest types, was produced. In producing this map, the latest techniques in digital image mosaicking were combined with the highspeed processing capability available on the ILLIAC IV parallel processor and other computer systems at the Ames Research Center (ARC). An operational and very responsive analysis method was developed at ARC that permitted on-time response to weekly workshops conducted with CDF field personnel to identify all 1,200 spectral classes and to produce final products. Over 100,000,000 acres were classified in the period between December 1, 1978, and April 15, 1979. All analyses were conducted using existing software. G.R.

A81-49764 * # Technical aspects of forest inventory demonstrations using Landsat data - Projects in the Pacific Northwest States. D. L. Peterson, G. Gnauk (NASA, Ames Research Center, Moffett Field, CA), and D. Noron (ESL, Inc., Sunnyvale, CA). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. (A81-49751 24-43) Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 105, 106.

CHEMICAL RESEARCH PROJECTS OFFICE

NASA CONTRACTOR REPORTS

X81-10140*# Sierracin Corp., Sylmar, Calif.
STUDY OF IMPROVED ENVIRONMENTAL STABILITY OF EPOXY TRANSPARENT MATERIALS
S. M. Hunter Mar. 1978 54 p refs
(Contract NAS2-9445)
(NASA-CR-152090) Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

Techniques for protecting the NASA/Ames developed epoxy transparency EX-112 from environmental damage were studied. An additive system comprised of the ultraviolet absorber Cyasorb 1988 and the antioxidant Goodrite 3125 was shown to afford considerable protection to EX-112. A laminated configuration in which the faceply was an acrylic containing an ultraviolet absorber

provided excellent protection to EX-112 with the added potential of impact resistance and field maintenance. A.R.H.

N81-17175*# HITCO, Gardena, Calif. Defense Products Div.
FABRICATION AND PHYSICAL TESTING OF GRAPHITE COMPOSITE PANELS UTILIZING WOVEN GRAPHITE FABRIC WITH CURRENT AND ADVANCED STATE-OF-THE-ART RESIN SYSTEMS Final Report
Samuel C. S. Lee Jun. 1979 26 p refs
(Contract NAS2-9977)
(NASA-CR-152292) Avail: NTIS HC A03/MF A01 CSCL 11D

Three weaves were evaluated; a balanced plain weave, a balanced 8-harness satin weave, and a semiunidirectional crowfoot satin weave. The current state-of-the-art resin system selected was Fiberite's 934 Epoxy; the advanced resin systems evaluated were Phenolic, Phenolic/Novolac, Benzyl and Bismaleimide.

The panels were fabricated for testing on NASA/Ames Research Center's Composites Modification Program. Room temperature mechanical tests only were performed by Hitco; the results are presented. T.M.

N81-18097* HITCO, Gardena, Calif. Defense Products Div. **DEVELOPMENT OF ASSEMBLY TECHNIQUES FOR FIRE RESISTANT AIRCRAFT INTERIOR PANELS Final Report** Samuel C. S. Lee May 1978 67 p refs (Contract NAS2-9153) (NASA-CR-152119; HTR-5-78) Avail: NTIS HC A04/MF A01 CSCL 11D

Ten NASA Type A fire resistant aircraft interior panels were fabricated and tested to develop assembly techniques. These techniques were used in the construction of a full scale lavatory test structure for flame propagation testing. The Type A panel is of sandwich construction consisting of Nomex honeycomb filled with quinone dioxime foam, and bismaleimide/glass face sheets bonded to the core with polyimide film adhesive. The materials selected and the assembly techniques developed for the lavatory test structure were designed for obtaining maximum fire containment with minimum smoke and toxic emission.

Author

N81-18139* San Jose State Coll., Calif. **DYNAMIC, HOT SURFACE IGNITION OF AIRCRAFT FUELS AND HYDRAULIC FLUIDS Final Report, Jan. 1977 - Dec. 1979** Donald J. Myronuk Oct. 1980 47 p refs (Grants NSG-2165; NSG-2219; AFOSR MIPR FY 1455-77; AF Proj. 3048) (NASA-CR-163979; AD-A094382; AFAPL-TR-79-2095) Avail: NTIS HC A03/MF A01 CSCL 21/4

The dynamic surface ignition characteristics of aircraft fuels and hydraulic fluids were investigated on heated stainless steel and titanium surfaces. Local air flow (0.8 to 50 meters per second) (2.4 to 152.4 ft/sec) effects were measured. Aircraft fuels evaluated on titanium surfaces ignited (25 to 75 C) (77 to 167 F) lower (500 to 600 C) (932 to 1112 F) than values required to ignite the fuels on a heated stainless steel surface. Higher local surface air speeds necessitated higher surface temperatures for ignition of an applied fluid. The same trends were noted for hydraulic fluids sprayed on the heated surfaces.

GRA

N81-18197* Utah Univ., Salt Lake City. Flammability Research Center. **FLAMMABILITY SCREENING TESTS OF RESINS Final Report** R. W. Arhart, D. G. Farrar, and B. M. Hughes Oct. 1979 135 p refs (Contract NAS2-9950) (NASA-CR-152312; UTEC-79-140) Avail: NTIS HC A07/MF A01 CSCL 11G

Selected flammability characteristics of glass cloth laminates of thermosetting resins are evaluated. A protocol for the evaluation of the flammability hazards presented by glass cloth laminates of thermosetting resins and the usefulness of that protocol with two laminates are presented. The glass laminates of an epoxy resin, M-751 are evaluated for: (1) determination of smoke generation from the laminates; (2) analysis of products of oxidative degradation of the laminates; (3) determination of minimum oxygen necessary to maintain flaming oxidation; (4) evaluation of toxicological hazards. S.F.

N81-22191* Idaho Univ., Moscow. Dept. of Chemical Engineering. **PERFLUOROETHER TRIAZINE ELASTOMERS Final Report, 1 Mar. 1980 - 28 Feb. 1981** Roger A. Korus 28 Feb. 1981 9 p refs (Grant NSG-2367)

(NASA-CR-164194) Avail: NTIS HC A02/MF A01 CSCL 07C

The synthesis of high performance elastomers with the high thermal stability and chemical inertness of perfluoroalkylene triazine and a low glass transition temperature is discussed. Perfluoroether triazine elastomers were proposed as potentially superior. It is concluded that the difficulties experienced in fluoroalkyltriazine elastomer synthesis can be overcome by a four-step reaction process involving chain extension, triazine ring closure, crosslinking, and elastomer curing. Molecular weight can be controlled in the initial polymer formation so that elastomer modulus can be determined. The final product elastomers exhibit a useful elastomeric range of approximately 45 to 325 C with an oxidative stability superior to other broad range elastomers. M.G.

N81-23058* Douglas Aircraft Co., Inc., Long Beach, Calif. **STUDY TO DEVELOP IMPROVED FIRE RESISTANT AIRCRAFT PASSENGER SEAT MATERIALS Final Report, 4 Dec. 1979 - 30 Sep. 1980** Fred E. Duskin, Kenneth J. Schutter, Howard H. Sieth, and Edward L. Trabold Aug. 1980 128 p refs (Contract NAS2-9337) (NASA-CR-152408; MDC-J4665) Avail: NTIS HC A07/MF A01 CSCL 01C

The Phase 3 study of the NASA 'Improved Fire Resistant Aircraft Seat Materials' involved fire tests of improved materials in multilayered combinations representative of cushion configurations. Tests were conducted to determine their thermal, smoke, and fire resistance characteristics. Additionally, a 'Design Guideline' for Fire Resistant Passenger Seats was written outlining general seat design considerations. Finally, a three-abreast 'Tourist Class' passenger seat assembly fabricated from the most advanced fire-resistant materials was delivered. Author

N81-24035* Douglas Aircraft Co., Inc., Long Beach, Calif. **STUDY OF AIRCRAFT CRASHWORTHINESS FOR FIRE PROTECTION Final Report, 15 Apr. 1980 - 28 Feb. 1981** A. Cominsky Jan. 1981 127 p refs (Contract NAS2-10583) (NASA-CR-166159) Avail: NTIS HC A07/MF A01 CSCL 01C

Impact-survivable postcrash fire accidents were surveyed. The data base developed includes foreign and domestic accidents involving airlines and jet aircraft. The emphasis was placed on domestic accidents, airlines, and jet aircraft due principally to availability of information. Only transport category aircraft in commercial service designed under FAR Part 25 were considered. A matrix was prepared to show the relationships between the accident characteristics and the fire fatalities. Typical postcrash fire scenarios were identified. Safety concepts were developed for three engineering categories: cabin interiors - cabin subsystems; power plant - engines and fuel systems; and structural mechanics - primary and secondary structures. The parameters identified for concept evaluation are cost, effectiveness, and societal concerns. Three concepts were selected for design definition and cost and effectiveness analysis: improved fire-resistant seat materials; anti-misting kerosene; and additional cabin emergency exits. J.M.S.

N81-26185* Southwest Research Inst., San Antonio, Tex. Dept. of Fire Technology. **FIRE TEST METHODOLOGY FOR AEROSPACE MATERIALS. 1: THERMAL AND SMOKE TOXICOLOGICAL ASSESSMENTS OF GRAPHITE/BISMALEIMIDE AND GRAPHITE/EPOXY SYSTEMS Final Report** M. D. Kanakia, W. G. Switzer, G. E. Hartzell, and H. L. Kaplan Oct. 1980 124 p refs (Contract NAS2-10140) (NASA-CR-166196; SWRI-03-5565-001) Avail: NTIS HC A06/MF A01 CSCL 11D

Both materials possess a high degree of thermal stability, with total heat release values being essentially identical under

piloted ignition conditions over a range of 5 to 10 W/sq cm incident heat flux. The graphite/epoxy material had a tendency to auto-ignite at a lower heat flux (about 7 W/sq cm) and produced about 23 percent higher peak heat release rates, approximately 42 percent more carbon monoxide and considerably more smoke than the graphite/bismaleimide under conditions of piloted ignition. Toxicological potencies of smoke produced from the two composites were equivalent for 30 minute exposures. Potencies were also comparable to many common materials, such as wood. There was no evidence for the formation of an 'unusual toxicant' nor for any short term post-exposure toxicological effects. T.M.

N81-27205*# SRI International Corp., Menlo Park, Calif. Engineering Sciences Lab.

CARBON FIBER MODIFICATION Final Report, 23 Oct. 1978 - 1 Aug. 1979

Thomas E. Thompson 9 Nov. 1979 22 p refs

(Contract NAS2-10091; SRI Proj. 7976)

(NASA-CR-166201) Avail: NTIS HC A02/MF A01 CSCL 11D

The effect of several chemical treatments on the electrical and mechanical properties of carbon fibers was investigated with an optimum goal of increasing the electrical resistivity by a factor of 1000 without appreciably changing the mechanical properties. It was possible to effect resistivity increases from 10 to 50 percent without adversely affecting the tensile strength or Young's modulus for T-300 and C-6000 PAN fibers by treatments with either $AlCl_3$ or nitric acid mixtures. Larger increases in the resistivity were produced with pitch fibers treated with nitric acid mixtures. This treatment also produced a partial decomposition of the pitch fiber and deterioration of the mechanical properties. The rationale behind the approach was to immobilize the conductivity producing pi electrons in the microscopic aromatic structure of the carbon fibers without destroying the strength producing sigma bonds. The investigations indicate that certain chemical treatments can produce such results, but the total reduction in the electrical conductivity which was achieved was not large enough to impact on problems which might arise from the high conductivities of the fibers. E.D.K.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-16598 * Modeling of exposure to carbon monoxide in fires. D. E. Cagliostro (NASA, Ames Research Center, Chemical Research Projects Office, Moffett Field, Calif.). *Journal of Combustion Toxicology*, vol. 7, Nov. 1980, p. 231-242. 11 refs.

A mathematical model is developed to predict carboxyhemoglobin concentrations in regions of the body for short exposures to carbon monoxide levels expected during escape from aircraft fires. The model includes the respiratory and circulatory dynamics of absorption and distribution of carbon monoxide and carboxyhemoglobin. Predictions of carboxyhemoglobin concentrations are compared to experimental values obtained for human exposures to constant high carbon monoxide levels. Predictions are within 20% of experimental values. For short exposure times, transient concentration effects are predicted. The effect of stress is studied and found to increase carboxyhemoglobin levels substantially compared to a rest state. (Author)

A81-23923 * Drag reduction - Jet breakup correlation with kerosene-based additives. J. W. Hoyt (Rutgers University, Piscataway, N.J.), R. L. Altman (NASA, Ames Research Center, Moffett Field, Calif.), and J. J. Taylor. *Journal of Rheology*, vol. 24, no. 5, 1980, p. 685-699. 6 refs.

The drag-reduction effectiveness of a number of high-polymer additives dissolved in aircraft fuel has been measured in a turbulent-flow rheometer. These solutions were further subjected to high elongational stress and breakup forces in a jet discharging in air. The jet was photographed using a high-resolution camera with special lighting. The object of the work was to study the possible spray-suppression ability of high-polymer additives to aircraft fuel and to correlate this with the drag-reducing properties of the additives. It was found, in fact, that the rheometer results indicate the most effective spray-suppressing additives. Using as a measure the minimum polymer concentration to give a maximum friction-reducing effect, the order of effectiveness of eight different polymer additives as spray-suppressing agents was predicted. These results may find application in the development of antimisting additives for aircraft fuel which may increase fire safety in case of crash or accident. (Author)

A81-24297 * # Photorearrangements of hydrocarbon polymers with pendant double bonds. M. A. Golub (NASA, Ames Research Center, Moffett Field, Calif.) and M. L. Rosenberg (NASA, Ames Research Center, Moffett Field; San Jose State University, San Jose, Calif.). (*American Chemical Society and Chemical Society of Japan, Chemical Congress, Honolulu, Hawaii, Apr. 1-6, 1979.*) *Journal of Polymer Science, Part A - Polymer Chemistry*, vol. 18, 1980, p. 2543-2560. 19 refs.

A81-42127 * Mass spectral studies of bisimides. I. K. Varma (NASA, Ames Research Center, Chemical Research Projects Office, Moffett Field, CA; Indian Institute of Technology, New Delhi, India), G. M. Fohlen, M.-T. Hsu, and J. A. Parker (NASA, Ames Research Center, Chemical Research Projects Office, Moffett Field, CA). *Organic Mass Spectrometry*, vol. 16, no. 3, 1981, p. 145, 146.

CONFERENCE AND MEETING PAPERS

N81-19061*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FIREWORTHINESS OF TRANSPORT AIRCRAFT INTERIOR SYSTEMS

John A. Parker and D. A. Kourtidis /In NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl. Pt. 2 Mar. 1981 p 453-479 refs (For primary document see N81-19056 10-03)

Avail: NTIS HC A17/MF A01 CSCL 01C

The key materials question is addressed concerning the effect of interior systems on the survival of passengers and crew in the case of an uncontrolled transport aircraft fire. Technical opportunities are examined which are available through the modification of aircraft interior subsystem components, modifications that may reasonably be expected to provide improvements in aircraft fire safety. Subsystem components discussed are interior panels, seats, and windows. By virtue of their role in real fire situations and as indicated by the results of large scale simulation tests, these components appear to offer the most immediate and highest payoff possible by modifying interior materials of existing aircraft. These modifications have the potential of reducing the rate of fire growth, with a consequent reduction of heat, toxic gas, and smoke emission throughout the habitable interior of an aircraft, whatever the initial source of the fire. E.D.K.

N81-19062*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMBUSTION TOXICOLOGY OF EPOXY/CARBON FIBER COMPOSITES

D. E. Cagliostro *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 481-497 (For primary document see N81-19056 10-03)
Avail: NTIS HC A17/MF A01 CSCL 01C

A combustion toxicology test was developed to screen materials for aerospace applications. The system is called the radiant panel test facility. A description of the facility and some preliminary results from tests on a Navy 3501-6AS composite, a typical composite for fighter aircraft, are presented. E.D.K.

N81-19071* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXTINGUISHING IN-FLIGHT ENGINE FUEL-LEAK FIRES WITH DRY CHEMICALS

Robert L. Altman *In* NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 2 Mar. 1981 p 855-868 refs (For primary document see N81-19056 10-03)
Avail: NTIS HC A17/MF A01 CSCL 01C

The fire extinguishant storage temperature requirements were examined for several commercially available dry chemicals. Particular emphasis was placed on the development of dry powder extinguishant that, when discharged into a jet engine fuel leak fire, would stick to the hot surfaces. Moreover, after putting out the initial fire, these extinguishants would act as antireignition catalysts, even when the fuel continued to leak onto the heated surface. R.C.T.

N81-28162* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ADVANCED RESIN SYSTEMS FOR GRAPHITE EPOXY COMPOSITES Final Report c24

W. J. Gilwee and A. Jayarajan *In* American Chemical Society The 16th Natl. Symp. on Polymers in the Serv. of Man 1980 p 131-135 refs (For primary document see N81-28146 19-23)
Avail: NTIS HC A09/MF A01 CSCL 11D

The value of resin/carbon fiber composites as lightweight structures for aircraft and other vehicle applications is dependent on many properties: environmental stability, strength, toughness, resistance to burning, smoke produced when burning, raw material costs, and complexity of processing. A number of woven carbon fiber and epoxy resin composites were made. The epoxy resin was commercially available tetraglycidylmethylethylene dianiline. In addition, composites were made using epoxy resin modified with amine and carboxyl terminated butadiene acrylonitrile copolymer. Strength and toughness in flexure as well as oxygen index flammability and NBS smoke chamber tests of the composites are reported. E.D.K.

N81-28164* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPATIAL DISTRIBUTION OF VOLATILE COMPOUNDS IN GRAPHITE COMPOSITES Final Report c24

Michael A. Grayson (McDonnell Douglas Research Labs.), Clarence J. Wolf (McDonnell Douglas Research Labs.), and Demetrius A. Kourides *In* American Chemical Society The 16th Natl. Symp. on Polymers in the Serv. of Man 1980 p 141-147 refs (For primary document see N81-28146 19-23)
(NASA Order A-67827-B)

Avail: NTIS HC A09/MF A01 CSCL 11D

The distribution of water and other volatile compounds such as acetone and phenol was measured as a function of depth in four graphite resin matrix composites. Precision abrasion mass spectrometry was used to qualitatively and quantitatively characterize the indigenous volatile compounds in the as received condition and after drying in an environmentally controlled oven. The total amount of water in the composites varied from 0.12 wt% to 1.1 wt% and the times required to dry the samples ranged from less than 96 h to much greater than 555 h. E.D.K.

A81-39131 * Fireworthiness of transport aircraft interior systems. J. A. Parker and D. A. Kourides (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and*

Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1142. 13 p. 30 refs.

This paper presents an overview of certain aspects of the evaluation of the fireworthiness of transport aircraft interiors. First, it addresses the key materials question concerning the effect of interior systems on the survival of passengers and crew in the case of an uncontrolled fire. Second, it examines some technical opportunities that are available today through the modification of aircraft interior subsystem components, modifications that may reasonably be expected to provide improvements in aircraft fire safety. Cost and risk benefits still remain to be determined. (Author)

PATENTS

N81-14016* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PERFLUOROALKYL POLYTRIAZINES CONTAINING PENDENT IODODIFLUOROMETHYL GROUPS Patent

Robert W. Rosser (PCR, Inc., Gainesville, Fla.) and Theodore Psarras, inventors (to NASA) (PCR, Inc., Gainesville, Fla.) Issued 18 Nov. 1980 5 p Filed 8 May 1979 Supersedes N79-24153 (17 - 15, p 1960) Sponsored by NASA
(NASA-Case-ARC-11241-1; US-Patent-4,234,715;
US-Patent-Appl-SN-037066; US-Patent-Class-528-362;
US-Patent-Class-260-33.8F; US-Patent-Class-528-401;
US-Patent-Class-528-422) Avail: US Patent and Trademark Office CSCL 07D

New perfluoroalkyl polytriazines containing pendent iododifluoromethyl groups are prepared by the reaction of perfluoroalkyl dinitriles with ammonia to form poly(imidoilamidines), followed by the cyclization of the imidoilamidine groups with, e.g., various mixtures of a perfluoroacyl fluoride with an omega iodoperfluoroacyl fluoride. The polytriazines obtained can be cured by heat which causes crosslinking at the iododifluoromethyl groups by elimination of iodine and formation of carbon-to-carbon bonds.

Official Gazette of the U.S. Patent and Trademark Office

N81-17259* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PROCESS FOR THE PREPARATION OF FLUORINE CONTAINING CROSSLINKED ELASTOMERIC POLYTRIAZINE AND PRODUCT SO PRODUCED Patent

Robert W. Rosser and Roger A. Korus, inventors (to NASA) (San Jose State Univ.) Issued 30 Dec. 1980 5 p Filed 9 Apr. 1979 Supersedes N79-22301 (17 - 13, p 1696)
(NASA-Case-ARC-11248-1; US-Patent-4,242,498;
US-Patent-Appl-SN-028300; US-Patent-Class-528-362;
US-Patent-Class-528-401; US-Patent-Class-528-422;
US-Patent-Class-528-423) Avail: US Patent and Trademark Office CSCL 07D

Crosslinking elastomeric polytriazines are prepared by a 4 step procedure which consists of (1) forming a poly(imidoilamidine) by the reaction, under reflux conditions, of anhydrous ammonia with certain perfluorinated alkyl or alkylether dinitriles; (2) forming a linear polytriazine by cyclizing the imidoilamidine linkages by reaction with certain perfluorinated alkyl or alkylether acid anhydrides or halides; (3) extending the linear polytriazine chain by further refluxing in anhydrous ammonia; and (4) heating to cyclize the new imidoilamidine and thereby crosslink the polymer.

Official Gazette of the U.S. Patent and Trademark Office

N81-17262* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE 1,2,4-OXADIAZOLE ELASTOMERS Patent

Robert W. Rosser, Ibrahim M. Shalhoub (San Jose State Univ.), and Hanoi Kwong, inventors (to NASA) (San Jose State Univ.) Issued 13 Jan. 1981 5 p Filed 9 Apr. 1979 Supersedes N79-22302 (17 - 13, p 1696)

(NASA-Case-ARC-11253-1; US-Patent-4,245,085;
US-Patent-Appl-SN-028301; US-Patent-Class-528-310;
US-Patent-Class-528-362; US-Patent-Class-528-401;
US-Patent-Class-528-422) Avail: US Patent and Trademark
Office CSCL 07D

Crosslinked 1,2,4-oxadiazole elastomers were prepared either by thermally condensing a monomer having the formula $H_2N(HON)C-R-Q$, wherein Q is a triazine ring forming group such as nitrile or amidine, or by a mixture of said monomer with $RC(NOH)NH_2$, with R in these formulas standing for a bivalent organic radical containing fluorine, hydrogen, or trifluoromethyl. In the monomer charge, the overall proportions of amidoxime groups to triazine ring forming groups varies depending on the extent of crosslinking desired in the final polymer. The heat and chemical resistant elastomers disclosed can serve, for instance, as adhesives, caulking compounds, channel sealants, fuel tank liners. Official Gazette of the U.S. Patent and Trademark Office

N81-24256* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

BIFUNCTIONAL MONOMERS HAVING TERMINAL OXIME AND CYANO OR AMIDINE GROUPS Patent

Robert W. Rosser, Ibrahim M. Shalhoub (San Jose State Univ.), and Hanoi Kwongs, inventors (to NASA) (San Jose State Univ.) Issued 26 May 1981 5 p Filed 30 Apr. 1980 Division of US Patent Appl. SN-028301, filed 9 Apr. 1979

(NASA-Case-ARC-11253-3; US-Patent-4,269,787;

US-Patent-Appl-SN-145283; US-Patent-Class-260-465.5R;

US-Patent-Class-564-229; US-Patent-Class-528-310; ;

US-Patent-Appl-SN-028301) Avail: US Patent and Trademark Office CSCL 07C

The preparation of crosslinked 1,2,4-oxadiazole elastomers is described. The technique involves thermally condensing (1) a monomer having the formula $H_2N(HON)C-R-Q$, wherein Q is a triazine ring-forming groups such as nitrile or amidine or a

mixture of such group with amidoxime, or (2) a mixture of the same monomer with $R(C(NOH)NH_2)_2$, with R in these formulas standing for a bivalent organic radical. In the monomer charge, the overall proportions of amidoxime groups to triazine ring-forming groups varies depending on the extent of crosslinking desired in the final polymer.

Official Gazette of the U.S. Patent and Trademark Office

N81-27272* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

PHOSPHORUS-CONTAINING BISIMIDE RESINS Patent
Indra K. Varma (NAS-NRC, Washington, D.C.), George M. Fohlen (NAS-NRC, Washington, D.C.), and John A. Parker, inventors (to NASA) (NAS-NRC, Washington, D.C.) Issued 30 Jun. 1981 4 p Filed 5 Aug. 1980 Supersedes N80-31551 (18 - 22, p 2976)

(NASA-Case-ARC-11321-1; US-Patent-4,276,344;

US-Patent-Appl-SN-175452; US-Patent-Class-428-260;

US-Patent-Class-428-367; US-Patent-Class-428-408;

US-Patent-Class-428-902; US-Patent-Class-428-920;

US-Patent-Class-526-262; US-Patent-Class-528-228) Avail: US Patent and Trademark Office CSCL 07C

The production of fire-resistant resins particularly useful for making laminates with inorganic fibers such as graphite fibers is discussed. The resins are by (1) condensation of an ethylenically unsaturated cyclic anhydride with a bis(diaminophenyl) phosphine oxide, and (2) by addition polymerization of the bisimide so obtained. Up to about 50%, on a molar basis, of benzophenonetetracarboxylic acid anhydride can be substituted for some of the cyclic anhydride to alter the properties of the products. Graphite cloth laminates made with these resins show 800 C char yields greater than 70% by weight in nitrogen. Limiting oxygen indexes of more than 100% are determined for these resins.

Official Gazette of the U.S. Patent and Trademark Office

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IRAS TELESCOPE PROJECT OFFICE

CONFERENCE AND MEETING PAPERS

A81-36891 * Stray radiation and the Infrared Astronomical Satellite /IRAS/ telescope. R. J. Noll, R. Harned (Perkin-Elmer Corp., Danbury, Conn.), R. P. Breault (Breault Research Organization, Inc., Tucson, Ariz.), and R. Malugin (NASA, Ames Research Center, Moffett Field, Calif.). In: Radiation scattering in optical systems; Proceedings of the Seminar, Huntsville, Ala., September 30-October 1, 1980. (A81-36878 16-74) Bellingham, Wash., Society

of Photo-Optical Instrumentation Engineers, 1981, p. 119-136. 5 refs. NASA-supported research.

Stray light control is a major consideration in the design of infrared cryogenically cooled telescopes such as the Infrared Astronomical Satellite (IRAS). The basic design of the baffle system, and the placement, shape, and coating of the secondary support struts for the telescope subsystem are described. The intent of this paper is to highlight the stray light problems encountered while designing the system, and to illustrate how computer analysis can be a useful design aid. Scattering measurements of the primary mirror, and a full system level scatter measurement are presented. Comparisons of predicted performance with the measured results are also presented. (Author)

SPACE PROJECTS DIVISION

NASA FORMAL REPORTS

N81-15925* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

PIONEER: FIRST TO JUPITER, SATURN, AND BEYOND
Richard O. Fimmel, James VanAllen (Iowa Univ.), and Eric Burgess 1980 296 p refs Original contains color illustrations (NASA-SP-446) Avail: NTIS MF A01; SOD HC \$13.00 CSCL 03B

The Pioneer Program continues to achieve far beyond its original objectives because of the successful missions of Pioneers 10 and 11 which have been in space over 8 years and 7 years, respectively. An overview of the Pioneer Jupiter/Saturn mission is presented including the planning process; technical aspects of the spacecraft design and operation; and the scientific payloads and the experiments conducted during interplanetary flight and the flyby portion of the missions. Data obtained from the various experiments are analyzed. The imaging photopolarimeter is described and technical details of planetary images are examined. A.R.H.

NASA TECHNICAL MEMORANDA

N81-16415* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SUPERFLUID HELIUM LEAK SEALANT STUDY

John W. Vorreiter Jan. 1981 19 p refs
(NASA-TM-81212; A-8233) Avail: NTIS HC A02/MF A01 CSDL 20D

Twenty-one leak specimens were fabricated in the ends of stainless steel and aluminum tubes. Eighteen of these tubes were coated with a copolymer material to seal the leak. The other three specimens were left uncoated and served as control specimens. All 21 tubes were cold shocked in liquid helium 50 times and then the leak rate was measured while the tubes were submerged in superfluid helium at 1.7 K. During the cold shocks two of the coated specimens were mechanically damaged and eliminated from the test program. Of the remaining 16 coated specimens one suffered a total coating failure and resulting high leak rate. Another three of the coated specimens suffered partial coating failures. The leak rates of the uncoated specimens were also measured and reported. The significance of various leak rates is discussed in view of the infrared astronomical satellite (IRAS) Dewar performance. Author

N81-18971* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PIONEER: FIRST TO JUPITER, SATURN, AND BEYOND. BIBLIOGRAPHY

1980 30 p Supplement to NASA-SP-446
(NASA-TM-81233) Avail: NTIS HC A03/MF A01 CSDL 03B

The reference citations are grouped by experiment. Experiments include: the charged particle instrument experiment; the ultraviolet photometer experiment; imaging experiments; and magnetometer experiments. The asteroid detector experiment and the plasma analyzer experiment are also included. T.M.

N81-21000* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SURFACE PENETRATORS FOR PLANETARY EXPLORATION: SCIENCE RATIONALE AND DEVELOPMENT PROGRAM

James P. Murphy, Ray T. Reynolds, Maxwell B. Blanchard, and Uel S. Clanton Mar. 1981 54 p refs
(NASA-TM-81251; A-8412) Avail: NTIS HC A04/MF A01 CSDL 03B

Work on penetrators for planetary exploration is summarized. In particular, potential missions, including those to Mars, Mercury, the Galilean satellites, comets, and asteroids are described. A baseline penetrator design for the Mars mission is included, as well as potential instruments and their status in development. Penetration tests in soft soil and basalt to study material eroded from the penetrator; changes in the structure, composition, and physical properties of the impacted soil; seismic coupling; and penetrator deflection caused by impacting rocks, are described. Results of subsystem studies and tests are given for design of entry decelerators, high-g components, thermal control, data acquisition, and umbilical cable deployment. M.G.

NASA CONTRACTOR REPORTS

N81-17866* Lockheed Missiles and Space Co., Sunnyvale, Calif.

SYSTEMS LEVEL FEASIBILITY STUDY FOR THE DETECTION OF EXTRA-SOLAR PLANETS. VOLUME 1: INFRARED INTERFEROMETER (IRIS) KNOWN AS THE STANFORD CONCEPT Final Report

Jun. 1979 153 p

(Contract NAS2-10030)

(NASA-CR-152253; LMSC-D676424-Vol-1) Avail: NTIS HC A08/MF A01 CSDL 03A

A sensor system for the direct detection of extrasolar planets from an Earth orbit is evaluated: a spinning, infrared interferometer (IRIS). It is shuttle deployed, free flying, requires no on-orbit assembly and no resupplying over a design life of five years. The sensor concept and the mission objectives are reviewed, and the performance characteristics of a baseline sensor for standard observation conditions are derived. A baseline sensor design is given and the enabling technology discussed. Cost and weight estimates are performed; and a schedule for an IRIS program including technology development and assessment of risk are given. Finally, the sensor is compared with the apodized visual telescope sensor (APOTS) proposed for the same mission. The major conclusions are: that with moderate to strong technology advances, particularly in the fields of long life cryogenics, dynamical control, mirror manufacturing, and optical alignment, the detection of a Jupiter like planet around a Sunlike star at a distance of 30 light years is feasible, with a 3 meter aperture and an observation time of 1 hour. By contrast, major and possibly unlikely breakthroughs in mirror technology are required for APOTS to match this performance. M.G.

N81-23991* Illinois Univ., Urbana. Dept. of Chemistry.

STUDIES OF THE ROLE OF METASTABLES AND DOUBLY IONIZED SPECIES IN THE CHEMICAL AND THERMAL STRUCTURE OF THE VENUSIAN AND MARTIAN IONOSPHERES Progress Report

Jane L. Fox 29 May 1981 7 p refs
(Grant NAG2-94)

(NASA-CR-164329) Avail: NTIS HC A02/MF A01 CSDL 03B

Models of the upper atmospheres of Mars and Venus were constructed using Viking and Pioneer Venus data. The neutral densities, with the exception of NO, N(4S), N(2D) and N(2P) were taken from the measured values, along with the neutral, ion, and electron temperatures. Using solar fluxes and relevant cross sections, the production rates of ions and neutral fragments by photo and electron impact processes were computed. These production rates were combined with chemical production rates and loss along with one dimensional transport eddy diffusion, molecular and ambipolar diffusion, and thermal diffusion, to determine the densities of ions and odd nitrogen species. Preliminary calculations show that the chemistry of metastables and doubly ionized species is important in the ionospheres of Mars and Venus. Production of N(+) in metastable reactions is particularly important, and it explains the discrepancy between the measurements of earlier models. Production of CO(+) is also affected. Reactions of O(++) and O(+)(2D) with N2 have important consequences for the escape rate of atomic nitrogen from the Martian atmosphere. A.R.H.

N81-25279* Motorola, Inc., Scottsdale, Ariz.

HYBRID RECEIVER CONCEPTUAL DESIGN AND TEST REPORT Final Report

Stephen W. Klare and James J. Crawford 31 May 1978 85 p refs

(Contract NAS2-9707)

(NASA-CR-152137) Avail: NTIS HC A05/MF A01 CSDL 17B

The Hybrid Receiver described uses an acquisition and demodulation scheme tailored to the Jovian environment. The large Doppler offsets expected during initial acquisition led to development of the Hilbert Acquisition Aid, which provides for rapid acquisition for low signal to noise densities. S.F.

N81-27048* Flow Research, Inc., Kent, Wash.

NUMERICAL SOLUTION OF TRANSONIC FULL STREAM FUNCTION EQUATIONS IN CONSERVATION FORM Final Report

Mohamed M. Hafez Oct. 1979 36 p refs
(Contract NAS2-10252)
(NASA-CR-166200; Rept-178) Avail: NTIS HC A03/MF A01
CSCL 01A

The stream function equation in conservation form is solved iteratively based on the artificial compressibility method. The density is not a unique function of the mass flux. In order to avoid the ambiguity near the sonic line, the density is updated in terms of the velocity, which is obtained through a simple integration of a first order equation step by step in the flow field. Iteration algorithms and finite difference approximations are discussed and numerical results of both conservative and nonconservative calculations are presented. E.D.K.

N81-27951*# Arizona Univ., Tucson.
HIGH SENSITIVITY OPERATION OF DISCRETE SOLID STATE DETECTORS AT 4 K Final Report
G. H. Rieke, E. F. Montgomery, M. J. Lebofsky, and P. R. Eisenhardt [1981] 16 p refs
(Contract NAS2-10227; Grants NSF AST-76-81874; NSF AST-78-22482)
(NASA-CR-166217) Avail: NTIS HC A02/MF A01 CSCL 20L

Techniques are described to allow operation of discrete, solid state detectors at 4 K with optimized JFET amplifiers. Three detector types cover the 0.6 to 4 mm spectral range with NEP approximately equal to 10 to the 16th power Hz (-1/2) for two of the types and potential improvement to this performance for the third. Lower NEP's are anticipated at longer infrared wavelengths. R.C.T.

N81-29047*# Carson Alexiou Corp., Costa Mesa, Calif.
NASA AMES INFRARED DETECTOR ASSEMBLIES Final Report
15 Oct. 1979 23 p
(Contract NAS2-10136)
(NASA-CR-166215) Avail: NTIS HC A02/MF A01 CSCL 03A

Silicon: Gallium infrared detector assemblies were designed, fabricated, and tested using techniques representative of those employed for hybrid arrays to determine the suitability of this candidate technology for infrared astronomical detector array applications. Both the single channel assembly and the assembly using a 32 channel CMOS multiplexer are considered. The detector material was certified to have a boron background of less than 10 to the 13th power atoms/sq cm counter doped with phosphorus. The gallium concentration is 2 x 10 to the 16th power atoms/cu cm. A.R.H.

N81-29964*# Breault Research Organization, Tucson, Ariz.
INFRARED ASTRONOMICAL SATELLITE (IRAS) ANALYSIS OF THE TRANSMITTANCE OF OFF-AXIS ENERGY DUE TO SCATTERING AND DIFFRACTION Final Report
Robert P. Breault, Alan W. Greynolds, Thomas A. Sargent, Steven R. Lange, and Arvind Marathay 30 Jun. 1978 157 p refs
(Contract NAS2-9966)
(NASA-CR-166227) Avail: NTIS HC A08/MF A01 CSCL 20F

Stray light transmittance is analyzed. Mathematical models are evaluated. The results of scatter and diffraction are considered separately, and the combined transmittance values evaluated. For individual titles, see N81-29965 through N81-29968.

N81-32416*# California Univ., Los Angeles. School of Engineering and Applied Science.
VAPOR-LIQUID PHASE SEPARATOR PERMEABILITY RESULTS Annual Report, Fall 1980 - Sep. 1981
S. W. K. Yuan and T. H. K. Frederking Oct. 1981 40 p refs
(Grant NCC2-64)

(NASA-CR-164841; UCLA-ENG-8134) Avail: NTIS
HC A03/MF A01 CSCL 20D

Continued studies are described in the area of vapor-liquid phase separator work with emphasis on permeabilities of porous sintered plugs (stainless steel, nominal pore size 2 micrometer). The temperature dependence of the permeability has been evaluated in classical fluid using He-4 gas at atmospheric pressure and in He-2 on the basis of a modified, thermosmotic permeability of the normal fluid. Author

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-20024 * # Magnetic refrigeration in space - Practical considerations. P. Kittel (NASA, Ames Research Center, Space Projects Div., Moffett Field, Calif.). *Journal of Energy*, vol. 4, Nov.-Dec. 1980, p. 266-272. 25 refs.

Various schemes of using adiabatic demagnetization to provide refrigeration in the 10-1000 mK range are discussed with particular reference to the requirements for use in space. The methods considered are complete demagnetization, isothermal demagnetization, moving magnet demagnetization, and continuous refrigeration. The requirements that are important for use in space are low mass, low power dissipation, high mechanical rigidity, modular design, and ease of use. (Author)

A81-21638 * Production of 1.25 K He-4 without He-4 superfluid film. J. H. Goebel (NASA, Ames Research Center, Moffett Field, Calif.). *Review of Scientific Instruments*, vol. 51, Dec. 1980; p. 1614-1617. 11 refs.

A refrigeration process is described which enables the production of a sub-gamma-point He-4 temperatures without the production of superfluid. The advantages of the process for zero gravity and low-noise refrigeration are described. The lowest temperature produced to date is 1.25 K. The process is also useful with other gases for refrigeration; the output temperature is selected by gas type. (Author)

A81-26262 * Simple models of the thermal structure of the Venusian ionosphere. R. C. Whitten (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.) and W. C. Knudsen (Lockheed Research Laboratories, Palo Alto, Calif.). *Icarus*, vol. 44, Oct. 1980, p. 85-92. 22 refs. Contract No. NAS2-9481.

Analytical and numerical models of plasma temperatures in the Venusian ionosphere are proposed. The magnitudes of plasma thermal parameters are calculated using thermal-structure data obtained by the Pioneer Venus Orbiter. The simple models are found to be in good agreement with the more detailed models of thermal balance. Daytime and nighttime temperature data along with corresponding temperature profiles are provided. L.S.

A81-27912 * # Satellites for the detection of nonsolar planets. L. W. Bandermann, R. H. Pohle (Lockheed Research Laboratories, Palo Alto, Calif.), J. P. Murphy, J. W. Vorreiter, and D. C. Black (NASA, Ames Research Center, Moffett Field, Calif.). (*American Institute of Aeronautics and Astronautics and NASA, Conference on Advanced Technology for Future Space Systems, Hampton, Va., May 8-11, 1979, AIAA Paper 79-0949*) *Journal of Spacecraft and Rockets*, vol. 18, Mar.-Apr. 1981, p. 164-171. 6 refs. Contract No. NAS2-100309.

Two sensor systems for the direct detection of nonsolar planets from earth orbit are evaluated: (1) an apodized visual telescope (APOTS), and (2) a spinning infrared interferometer (IRIS). Their

performance characteristics and technology requirements for a five-year mission are determined. The simpler instrument, APOTS, requires a substantial improvement in mirror fabrication techniques before it can approach its full performance potential. The IRIS requires technology development in the areas of long-lifetime cryogenic systems and of active control techniques. Technology issues of secondary importance are discussed. (Author)

A81-28480 * # Optical search for lightning on Venus. W. J. Borucki (NASA, Ames Research Center, Theoretical and Planetary Studies Branch, Moffett Field, Calif.), J. W. Dyer (NASA, Ames Research Center, Pioneer Projects Office, Moffett Field, Calif.), G. Z. Thomas (Hughes Aircraft Co., Los Angeles, Calif.), J. C. Jordan (Informatics, Inc., Palo Alto, Calif.), and D. A. Comstock (De Anza College, Cupertino, Calif.). *Geophysical Research Letters*, vol. 8, Mar. 1981, p. 233-236. 27 refs. Contract No. NAS2-8300.

Electrical signals attributed to lightning events on Venus have been observed by instruments aboard Veneras 11 and 12 and aboard the Pioneer Venus Orbiter. This paper reports the results of a search for optical pulses from the dark side of Venus made with the star sensor aboard the Pioneer Venus Orbiter. A comparison of both the frequency and amplitude distributions of received pulses with those of control experiments in which the star sensor observed deep space showed no statistically significant differences. Based on observations made during orbits 300 through 345, an upper limit of 30 flashes/sq km/yr has been derived for the average lightning frequency on the dark side of Venus. This value assumes that the amplitude distribution of lightning and the attenuation of the optical pulse by clouds on Venus are not substantially different from that occurring on earth. (Author)

A81-37863 * Identification of new infrared bands in a carbon-rich Mira variable. J. H. Goebel, J. D. Bregman, F. C. Witteborn, B. J. Taylor (NASA, Ames Research Center, Moffett Field, CA), and S. P. Willner (California, University, San Diego, CA). *Astrophysical Journal, Part 1*, vol. 246, June 1, 1981, p. 455-463. 56 refs.

Complete 0.75-13 micron spectrometry of a carbon-rich, Mira-class variable star is presented for the first time. It is noted that although the near-infrared is dominated by photospheric absorption bands of the CN red system, the infrared becomes progressively dominated by the bands of the polyatomic molecules HCN and C₂H₂. Since the band at 3.1 microns is known to be due to HCN and C₂H₂, it is possible to associate bands at 1.04, 1.53, 1.85, 2.5, 2.7, 3.56, 3.85, 4.8, and 7.1 microns with HCN and C₂H₂. The spectrum suggests that radiative transfer in the carbon Mira class cannot be discussed quantitatively without the inclusion of HCN and C₂H₂ opacity. On the basis of the carbon star models of Querci and Querci (1974), it is deduced that the abundance ratio of HCN to C₂H₂ can be used to indicate whether 3-alpha-processed or CNO-processed material is in the outer atmosphere. An 11.3 micron SiC dust-emission feature is present, although it differs significantly from the 11.7 micron SiC feature in Y CVn. A featureless emission is present from 4 to 13 microns and can be ascribed to optically thin graphite grains having a temperature of 450 K. C.R.

A81-47646 * # Infrared charge-injection-device array performance at low background. C. R. McCreight and J. H. Goebel (NASA, Ames Research Center, Moffett Field, CA). *Applied Optics*, vol. 20, Sept. 15, 1981, p. 3189-3196. 12 refs.

Low-background tests of a 1 x 32 Si:Bi charge-injection-device (CID) IR detector are carried out to evaluate its feasibility for space-based astronomical observations. Optimum performance is obtained at a temperature of 11 K. The sensitivity is found to compare well with that of discrete extrinsic silicon photoconductors. The measured sensitivity and the apparent absence of anomalous effects make extrinsic silicon CID arrays very promising for astronomical applications. C.R.

CONFERENCE AND MEETING PAPERS

A81-37199 * Development of a Shuttle Infrared Telescope Facility (SIRTF) fine guidance sensor. P. M. Salomon, T. A. Glavich, W. C. Goss (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and K. R. Lorell (California Institute of Technology, Jet Propulsion Laboratory, Pasadena; NASA, Ames Research Center, Moffett Field, Calif.). In: Shuttle pointing of electro-optical experiments; Proceedings of the Seminar, Los Angeles, Calif., February 10-13, 1981. (A81-37177 16-19) Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1981, p. 203-218. 15 refs. Contract No. NAS7-100.

Fine guidance technology development for the Shuttle Infrared Telescope Facility (SIRTF) centers upon the use of a single multiple-star-tracking sensor to provide the position information necessary to produce three-axis attitude control signals for precision payload pointing. The effort described in this paper is concerned with the development of a fine guidance sensor that employs a high-density charge-coupled imaging device for producing position information signals by using star fields. Multiple star position information produces three-axis position error signals that are used to update inertial reference gyros. The sensor employs advanced position interpolation algorithms to enhance field-of-view resolution and to correct for optical aberrations inherent in spatially chopped star images resulting from the telescope's movable secondary mirror. Operation of the sensor is under the control of a high-performance microcomputer that provides both autonomy and flexibility in a guidance application. (Author)

A81-37212 * Shuttle infrared telescope facility pointing and control system. K. R. Lorell, W. F. Barrows, and Y. T. Matsumoto (NASA, Ames Research Center, Moffett Field, Calif.). In: Shuttle pointing of electro-optical experiments; Proceedings of the Seminar, Los Angeles, Calif., February 10-13, 1981. (A81-37177 16-19) Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1981, p. 355-365. 14 refs.

The Shuttle Infrared Telescope Facility (SIRTF) is being designed as a 0.85 m cryogenically cooled telescope capable of a three order of magnitude improvement over currently available infrared instruments. The SIRTF requires that the image at the focal plane be stabilized to better than 0.25 arcsec with an absolute accuracy of 1.0 arcsec. Current pointing-mount performance simulations indicate that neither of these requirements can be met without additional stabilization. The SIRTF pointing and control system will utilize gyro outputs, star field position measurements from a focal plane fine guidance sensor, and a steerable secondary mirror to provide the necessary stabilization and pointing control. The charge coupled device fine guidance sensor tracks multiple stars simultaneously and, through the use of multistar processing algorithms in a high performance microcomputer, generates three-axis attitude errors and gyro-drift estimates to correct the pointing-mount gyros. A high-bandwidth feedforward loop, driven directly from the pointing-mount gyro package, controls the steering mirror in order to correct disturbances not compensated for by the pointing-mount control system. A prototype design for the SIRTF pointing and control system is described in detail. Performance analyses made using a digital simulation of the pointing and control system as well as experimental data obtained in laboratory and field test measurements are presented. (Author)

A81-37733 * A large-aperture space telescope for infrared and submillimeter astronomy. J. P. Murphy, M. K. Kiya, M. Werner (NASA, Ames Research Center, Moffett Field, CA), P. N. Swanson, T. B. H. Kuiper, and P. D. Batelaan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Active optical devices and applications; Proceedings of the Seminar, Washington, DC, April 10, 11, 1980. (A81-37719 17-74) Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1980, p. 117-127. 8 refs.

The Large Aperture Telescope (LAT), which will have a diameter of 10-30 m and will operate in the 2-1000 micron wavelength range, is described. It is noted that the LAT could be carried into orbit with a single launch of the Space Transportation System and semiautomatically deployed as a free flyer with a nominal 10-yr mission duration. Servicing and instrument changes would be made at 2-yr intervals. It is pointed out that the LAT would have to be placed above the earth's atmosphere to avoid both the absorption that occurs through much of the infrared and submillimeter and the turbulence which limits spatial resolution. Important technical considerations for the LAT are discussed; they include the telescope optical form, the primary mirror material, figure control techniques, the deployment techniques, and thermal control. The science objectives and rationale for the LAT are discussed and various hardware techniques and concepts for its implementation are described. C.R.

A81-39594 * Alignment and evaluation of the cryogenic corrected infrared astronomical satellite /IRAS/ telescope. N. Harned, R. Harned (Perkin-Elmer Corp., Norwalk, CT), and R.

Melugin (NASA, Ames Research Center, Moffett Field, CA). In: Optical alignment; Proceedings of the Seminar, San Diego, CA, July 29-31, 1980. (A81-39578 18-74) Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1980, p. 163-170. Contract No. NAS2-9700.

Room temperature alignment and evaluation techniques for the Infrared Astronomical Satellite (IRAS) telescope, which has a primary mirror figured to correct for surface distortions and the 2 K operating temperature are discussed. Interferometric cryogenic testing of the 0.6 m, f/1.5 lightweighted beryllium primary mirror at its intended operating temperature reveals surface distortions that can be modeled with Zernike polynomials. With this model, it becomes possible to derive the 'inverse' of the cryowavefront error (ideal cryo mirror) and to figure the cryo correction into the primary mirror using Perkin-Elmer's Computer Controlled Polisher. It is recognized that during room temperature assembly of the system, misalignment of the secondary mirror can introduce additional unwanted aberrations that may cancel or distort the wavefront errors purposely introduced by the cryo figuring. To avoid this possible degradation and to ensure optimum telescope performance, the system Zernike polynomial coefficients and wavefront maps generated from the in-process alignment interferograms are monitored and compared to Zernike coefficients and wavefront maps for the cryo corrected primary mirror. C.R.

SPACE SCIENCE DIVISION

NASA FORMAL REPORTS

N81-17622* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TWO-DIMENSIONAL MODEL STUDIES OF THE EFFECT OF SUPERSONIC AIRCRAFT OPERATIONS ON THE STRATOSPHERIC OZONE CONTENT
R. C. Whitten, W. J. Borucki, I. G. Poppoff (Flick Point Associates, Camelian Bay, Calif.), L. Latt (Aerospace Corp., El Segundo, Calif.), G. F. Widhopf (Aerospace Corp., El Segundo, Calif.), L. A. Capone (San Jose State Univ.), and C. A. Reigel (San Jose State Univ.)
Feb. 1981 72 p refs
(NASA-RP-1064; A-8270) Avail: NTIS HC A04/MF A01 CSDL 13B

For a fleet of 250 aircraft, the change in the ozone column is predicted to be very close to zero; in fact, the ozone overburden may actually increase as a result of show that above 25 to 30 km the ozone abundance decreases via catalytic destruction, but at lower heights it increases, mainly as a result of coupling with odd hydrogen species. Water vapor released in the engine exhaust is predicted to cause ozone decreases; for the hypothetical engines used in the study, the total column ozone changes due to water vapor emission largely offset the predicted ozone increases due to NOx emission. The actual effect of water vapor may be less than calculated because present models do not include thermal feedback. Feedback refers to the cooling effect of additional water vapor that would tend to slow the NOx reactions which destroy ozone. T.M.

NASA TECHNICAL MEMORANDA

N81-14938* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FRAGMENTATION IN ROTATING ISOTHERMAL PROTO-STELLAR CLOUDS
P. Bodenheimer (California Univ., Santa Cruz), J. E. Tohline (LASL), and D. C. Black 1980 7 p refs Presented at the 58th Intern. Astron. Union Colloq. on Stellar Hydrodyn., Los Alamos, N. Mex., Aug. 1980

(Contract W-7405-eng-26)

(NASA-TM-82229; LA-UR-80-2787; CONF-800872-5) Avail: NTIS HC A02/MF A01 CSDL 03A

Results of an extensive set of 3 D hydrodynamic calculations are presented. The calculations were performed to investigate the susceptibility of rotating clouds to gravitational fragmentation. DOE

NASA CONTRACTOR REPORTS

N81-22794* California Univ., San Diego. Dept. of Applied Mechanics and Engineering Sciences.
CROSS-BISPECTRUM COMPUTATION AND VARIANCE ESTIMATION
K. S. Li (California Univ., Riverside) and K. N. Helland [1981]
17 p refs
(Grant NSG-2376)
(NASA-CR-164219) Avail: NTIS HC A02/MF A01 CSDL 12A

A method for the estimation of cross-bispectra of discrete real time series is developed. The asymptotic variance properties of the bispectrum are reviewed, and a method for the direct estimation of bispectral variance is given. The symmetry properties are described which minimize the computations necessary to obtain a complete estimate of the cross-bispectrum in the right-half-plane. A procedure is given for computing the cross-bispectrum by subdividing the domain into rectangular averaging regions which help reduce the variance of the estimates and allow easy application of the symmetry relationships to minimize the computational effort. As an example of the procedure, the cross-bispectrum of a numerically generated, exponentially distributed time series is computed and compared with theory. Author

N81-22822* California Univ., San Diego, La Jolla. Dept. of Mathematics.
ESTIMATING THREE-DIMENSIONAL ENERGY TRANSFER IN ISOTROPIC TURBULENCE Final Scientific Report, 1 Mar. 1979 - 30 Oct. 1980

K. S. Li, K. N. Helland (California Univ., Riverside), and M. Rosenblatt 30 Oct. 1980 69 p refs
(Grant NSG-2376)
(NASA-CR-164217) Avail: NTIS HC A04/MF A01 CSCL 12A

To obtain an estimate of the spectral transfer function that indicates the rate of decay of energy, an x-wire probe was set at a fixed position, and two single wire probes were set at a number of locations in the same plane perpendicular to the mean flow in the wind tunnel. The locations of the single wire probes are determined by pseudo-random numbers (Monte Carlo). Second order spectra and cross spectra are estimated. The assumption of isotropy relative to second order spectra is examined. Third order spectra are also estimated corresponding to the positions specified. A Monte Carlo Fourier transformation of the downstream bispectra corresponding to integration across the plane perpendicular to the flow is carried out assuming isotropy. Further integration is carried out over spherical energy shells. E.A.K.

N81-23174* Kansas Univ., Lawrence.
PIONEER VENUS PROBE MODELS INSTRUMENTED PROPTES Final Report
Vincent U. Muirhead Aug. 1978 74 p refs
(Contract NAS2-9414)
(NASA-CR-164298; KU-FRL-333-1) Avail: NTIS
HC A04/MF A01 CSCL 22B

Models of both the small and large Pioneer Venus probes were dropped from a helicopter to simulate the conditions of Mach and Reynolds numbers to be encountered by the probes upon entry into the Venus atmosphere. The models were dropped at an average Mach number of .10 and at an average Reynolds number of 2.84 million for the small probe and 2.90 million for the large probe. After the large amplitude launching oscillations were damped, the small probe oscillations in angle of attack and in sideslip were generally less than 2 degrees. The large probe oscillations were generally less than 10 degrees. Both exhibited distinct frequencies. The motion of the small probe in a plane perpendicular to the z axis was random while the large probe rotated (corkscrewed) at 1.1 cycles per second about the z axis. The average drag coefficients of the probe models were .714 for the small probe and .663 for the large probe. M.G.

N81-27462* Lockheed Missiles and Space Co., Palo Alto, Calif.
DEVELOPMENT AND TESTING OF 2-DIMENSIONAL PHOTON COUNTER Final Report, 12 May 1980 - 12 Feb. 1981

12 Feb. 1981 11 p
(Contract NAS2-10618)
(NASA-CR-166204; LMSC-D770635) Avail: NTIS
HC A02/MF A01 CSCL 14B

The development of a commercially available two dimensional photon counter into an operational system for speckle imaging of astronomical objects is described. The system includes digital recording for field observations. The counter has a bialkali photocathode with a field size of 18 by 18 mm over which it resolves about 100 by 100 pixels. The system records photon positions as 16 bit words at rates up to 14,400 per second. Field tests at observatories verifying the operation of the system are described. J.D.H.

N81-28639* Washington Univ., Seattle. Dept. of Atmospheric Sciences.
MIDDLE ATMOSPHERE PROJECT: A RADIATIVE HEATING AND COOLING ALGORITHM FOR A NUMERICAL MODEL OF THE LARGE SCALE STRATOSPHERIC CIRCULATION
William M. Wehrbein and Conway B. Leovy Jul. 1981 67 p refs
(Grant NAG2-66)
(NASA-CR-164646; Rept-2) Avail: NTIS HC A04/MF A01 CSCL 04A

A Curtis matrix is used to compute cooling by the 15 micron and 10 micron bands of carbon dioxide. Escape of radiation to space and exchange the lower boundary are used for the 9.6 micron band of ozone. Voigt line shape, vibrational relaxation, line overlap, and the temperature dependence of line strength distributions and transmission functions are incorporated into the Curtis matrices. The distributions of the atmospheric constituents included in the algorithm, and the method used to compute the Curtis matrices are discussed as well as cooling or heating by the 9.6 micron band of ozone. The FORTRAN programs and subroutines that were developed are described and listed. A.R.H.

N81-29054* California Inst. of Tech., Pasadena. Geological and Planetary Sciences Div.
EVOLUTION OF THE ATMOSPHERE OF VENUS Final Technical Report, 1 Jan. 1980 - 30 Jun. 1981
Yuk L. Yung 30 Jun. 1981 89 p refs
(Contract NCC2-61)
(NASA-CR-164641) Avail: NTIS HC A05/MF A01 CSCL 03B

The photochemistry of the stratosphere of Venus was modeled using an updated and expanded chemical scheme, and the results of recent laboratory studies. The model satisfactorily accounts for the observations of CO, O₂, (1) and SO₂ in the stratosphere. Oxygen, derived from CO₂ photolysis, is primarily consumed by CO₂ recombination and oxidation of SO₂ to H₂SO₄. Photolysis of HCl in the upper stratosphere provides a major source of odd hydrogen radicals essential for the catalytic oxidation of CO. Oxidation of SO₂ by O occurs in the lower stratosphere, with the O-O bond broken by S + O₂ and SO + HO₂. The sensitivity of stratospheric chemistry to ambient H₂ abundance was studied and the model prefers the high value (1 10 ppm) recently inferred from the Pioneer Venus ionospheric measurements. The importance of the photochemical production of S₂O, (SO)₂, S₂, H₂S₂O₂ and H₂S₂O₃ is speculated. A number of previously unsuspected similarities between the chemistry of the stratospheres of Venus and the Earth, presented and discussed. A.R.H.

N81-29660* Stanford Research Inst., Menlo Park, Calif.
LIDAR MEASUREMENTS OF THE POST-FUEGO STRATOSPHERIC AEROSOL Final Report, Feb. - Nov. 1975
Philip B. Russell, Richard D. Hake, Jr., and William Viezee Apr. 1976 55 p refs
(Contract NAS2-8674; SRI Proj. 4019)
(NASA-CR-166210) Avail: NTIS HC A04/MF A01 CSCL 13B

Fifteen lidar observations of the stratospheric aerosol were made between February and November 1975. All observations revealed the greatly increased particulate backscattering that followed the eruption of the volcano Fuego in October 1974. Vertical structure consisted initially of multiple layers, which later merged to form a single, broader peak. Essentially all of the increased scattering was confined to altitudes below 20 km. Hence, aerosol layer centroids in 1975 were typically several km below their altitude prior to the eruption. Radiative and thermal consequences of the measured post-Fuego layer were computed using several recently published models. The models predict a temperature increase of several K at the altitude of the layer, caused by the infrared absorption bands of the sulfuric acid particles. The surface temperature decrease predicted by the models is considerably smaller than 1 K, partly because of the small optical thickness of the volcanic layer, and partly because of its short residence time relative to the earth-ocean thermal response time. Author

N81-32748* Desert Research Inst., Reno, Nev.
STRATOSPHERIC CCN SAMPLING PROGRAM Interim Report, 1 Apr. - 1 Oct. 1981
C. Fred Rogers 1 Oct. 1981 52 p refs
(Grant NAG2-114)
(NASA-CR-164838) Avail: NTIS HC A04/MF A01 CSCL 04A

When Mt. St. Helens produced several major eruptions in the late spring of 1980, there was a strong interest in the characterization of the cloud condensation nuclei (CCN) activity of the material that was injected into the troposphere and stratosphere. The scientific value of CCN measurements is two fold: CCN counts may be directly applied to calculations of the interaction of the aerosol (enlargement) at atmospherically-realistic relative humidities or supersaturations; and if the chemical constituency of the aerosol can be assumed, the number-versus-critical supersaturation spectrum may be converted into a dry aerosol size spectrum covering a size region not readily measured by other methods. The sampling method is described along with the instrumentation used in the experiments. T.M.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-10296 * # On the relationship between secular brightness changes of Titan and solar variability. J. B. Pollack, K. Rages, O. B. Toon (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.), and Y. L. Yung (California Institute of Technology, Pasadena, Calif.). *Geophysical Research Letters*, vol. 7, Oct. 1980, p. 829-832. 22 refs.

Titan's geometric albedo varied noticeably from 1972 to 1978, in phase with variations in solar activity (Lockwood and Thompson, 1979). A series of radiative transfer and aerosol formation calculations were made to demonstrate the feasibility of the following scenario for these secular brightness changes. Solar activity changes, especially in the UV output of the sun, result in alterations to the mass production rate of aerosols in Titan's atmosphere, which lead to modifications of their microphysical properties. The latter, in turn, cause the albedo to vary. Current estimates of the change in the solar UV radiation below the dissociation limit of methane imply alterations to the mean radius of the aerosols over an 11-yr solar cycle that are consistent in sign and magnitude with those required to explain the observed secular brightness changes. (Author)

A81-12821 * Theoretical profiles for the 1-0 S(1) H₂ line in carbon stars. D. Goorvitch, J. H. Goebel, and G. C. Augason (NASA, Ames Research Center, Moffett Field, Calif.). *Astrophysical Journal*, Part 1, vol. 240, Sept. 1, 1980, p. 588-596. 26 refs.

The spectra of carbon stars have been synthesized from the models of Querci, Querci, and Tsuji and Querci and Querci in the region of the 1-0 S(1) vibration-rotation quadrupole line of H₂. The line is shown to be sufficiently strong to be seen against the numerous lines of the CN red system for models with effective temperatures less than about 2700 K. The usefulness of the line as a diagnostic of the atmosphere is discussed, and a comparison with the measured spectra of UU Aur and S Cep is made. It is concluded that the outer atmospheric layers of carbon stars are significantly warmer than the models predict. An additional opacity source in the outer layers is required. (Author)

A81-14337 * Observations of the motion and distribution of the ionized gas in the central parsec of the Galaxy. II. J. H. Lacy, C. H. Townes (California, University, Berkeley, Calif.), T. R. Geballe (Mount Wilson and Las Campanas Observatories, Pasadena, Calif.), and D. J. Hollenbach (NASA, Ames Research Center, Moffett Field, Calif.). *Astrophysical Journal*, Part 1, vol. 241, Oct. 1, 1980, p. 132-146. 39 refs. Research supported by the University of California and NASA; NSF Grant No. AST-78-24453; Grant No. NGL-05-003-272.

Observations of infrared fine-structure line emission from compact clouds of ionized gas within Sgr A West are presented. These clouds have diameters of 0.1-0.5 pc, internal velocity

dispersions of 100 km/s (FWHM), and line center velocities up to + or - 260 km/s. Their masses are not accurately determined but are probably between 0.1 and 10 solar masses. They are ionized by radiation like that of stars of effective temperature not greater than 35,000 K. The clouds are shown to have lifetimes of 10,000 yr and so must be generated and dissipated at a rate of a few per 1000 yr. From analysis of the distribution of the velocities of the clouds, a most probable mass distribution is derived which includes a central pointlike mass of several $\times 10$ to the 6th solar masses in addition to several $\times 10$ to the 6th solar masses of stars within 1 pc of the center. (Author)

A81-14384 * Molecule formation and infrared emission in fast interstellar shocks. II - Dissociation speeds for interstellar shock waves. D. Hollenbach (NASA, Ames Research Center, Space Science Div., Moffett Field, Calif.) and C. F. McKee (California, University, Berkeley, Calif.). *Astrophysical Journal*, Part 2 - Letters to the Editor, vol. 241, Oct. 1, 1980, p. L47-L50. 28 refs. NSF Grant No. AST-77-23069.

The postshock destruction of molecules is examined, including the processes of (1) collisions with neutral hydrogen atoms and molecules, (2) electronic collisions, and (3) neutral chemical reactions with atoms, particularly atomic hydrogen. By using conservative estimates of collisional dissociation rates from individual vibrational states, it is found that process (1) leads to the destruction of molecular hydrogen behind shocks with speeds equal to or greater than 25 km/s if the preshock molecular gas has hydrogen nucleus densities of equal to or greater than 10 to the 4th/cu cm. At lower densities (100 per cu cm), destruction occurs for shock speeds equal to or greater than 50 km/s and process (2) dominates. Dissociation of molecules such as CO, H₂O, and O₂ follows the destruction of H₂, as the resultant hydrogen atoms chemically dissociate the metal atoms from their bonds (process 3) in the hot postshock gas. These results demonstrate that many of the observed high-speed interstellar molecules, if shock accelerated, must have dissociated and reformed in the postshock gas. (Author)

A81-14414 * Observations of large scale steady magnetic fields in the dayside Venus ionosphere. J. G. Luhmann, R. C. Elphic, C. T. Russell (California, University, Los Angeles, Calif.), J. D. Mihalov, and J. H. Wolfe (NASA, Ames Research Center, Moffett Field, Calif.). *Geophysical Research Letters*, vol. 7, Nov. 1980, p. 917-920. 10 refs. Contract No. NAS2-9491.

Although the dayside ionosphere of Venus is often field-free except for fine-scale features, large-scale steady ionospheric magnetic fields with magnitudes sometimes exceeding 100 gammas are occasionally observed by the Pioneer Venus Orbiter magnetometer. These fields are mainly horizontal and can assume any angle in the horizontal plane. The orientation of the field may change along the spacecraft trajectory. The field magnitude in the upper ionosphere usually shows a distinct minimum near approximately 200 km altitude, but the altitude profile is otherwise arbitrary. With few exceptions, the observations of these large scale fields occur when periapsis is at solar zenith angles less than 50 deg. The occurrence of large-scale fields is often coincident with the observation of high solar wind dynamic pressures by the Pioneer Venus Orbiter plasma analyzer closely following the ionosphere encounter. However, the detection of this phenomenon even during some orbits for which the dynamic pressure is not extraordinarily high suggests that other factors, such as hysteresis effects, must also play a role in determining the occurrence frequency of large-scale magnetic fields in the dayside Venus ionosphere. (Author)

A81-14425 * Reactivity of stratospheric aerosols to small amounts of ammonia in the laboratory environment. D. Hayes (LFE Environmental Laboratories, Richmond, Calif.), K. Snetinger, G. Ferry, V. Oberbeck, and N. Farlow (NASA, Ames Research Center,

Moffett Field, Calif.). *Geophysical Research Letters*, vol. 7, Nov. 1980, p. 974-976. 30 refs.

Trace ammonia in laboratory air reacts easily with sulfuric acid aerosol samples to form crystalline ammonium sulfate. Argon atmospheres, however, protect sampling surfaces from ammonia contamination. It is found that atmospheric aerosols treated in this way contain only sulfuric acid. After an hour exposed to laboratory air, these same samples convert to ammonium sulfate. Aerosol particles have been collected, using argon control, to determine if the absence of crystalline sulfate is common. But so far there is no evidence that aerosols are neutralized by ammonia in the stratosphere. (Author)

A81-14429 * Tidal dissipation in Europa - A correction. P. Cassen, R. T. Reynolds (NASA, Ames Research Center, Theoretical and Planetary Studies Branch, Moffett Field, Calif.), and S. J. Peale (Joint Institute for Laboratory Astrophysics, Boulder, Colo.; California, University, Santa Barbara, Calif.). *Geophysical Research Letters*, vol. 7, Nov. 1980, p. 987, 988. 5 refs. Grants No. NGR-05-010-062; No. NCA2-OR-680-805.

The possibility that tidal dissipation in a thin ice crust was sufficient to preserve liquid water on Jupiter's satellite Europa was suggested by Cassen et al. (1979). However, their calculation of the tidal heating rate for that situation is in error; for the same parameter values, the actual heating rate would be much less than given in their paper. Thus, their conclusion regarding the possibility that liquid water exists today on Europa is considerably weakened. This paper corrects the calculation of the tidal dissipation rate in a European ice crust, and discusses the implications for Europa's thermal history, and clarifies certain aspects of the tidal heating problem. (Author)

A81-14651 * Saturn's magnetosphere and its interaction with the solar wind. E. J. Smith (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), L. Davis, Jr. (California Institute of Technology, Pasadena, Calif.), D. E. Jones (Brigham Young University, Provo, Utah), P. J. Coleman, Jr. (California, University, Los Angeles, Calif.), D. S. Colburn, P. Dyal (NASA, Ames Research Center, Moffett Field, Calif.), and C. P. Sonett (Arizona, University, Tucson, Ariz.). *Journal of Geophysical Research*, vol. 85, Nov. 1, 1980, p. 5655-5674. 41 refs. Grant No. NGR-05-022-160; Contract No. NAS7-100.

The paper deals with the Pioneer 11 vector helium magnetometer observations of Saturn's planetary magnetic field, magnetosphere, magnetopause, and bow shock. Models based on spherical harmonic analyses of measurements inside 8 Saturn radii show that the planetary field has a high degree of symmetry about the rotation axis. The vector dipole moment has a tilt angle of less than 1 deg and is offset along the polar axis by 0.04 plus or minus 0.02 Saturn radius. Equatorial offsets derived from the models show pronounced variability and could be consistent with a very small offset. Large impulsive field compressions are observed in the magnetosheath near noon. Multiple crossings of the bow shock are observed, and the absence of significant changes in field direction indicates that it is quasi-perpendicular. V.P.

A81-15146 * Intensity of the sulfur dioxide rotational spectrum. R. J. Larkin, R. W. Lovejoy (Lehigh University, Bethlehem, Pa.), P. M. Silvaggio, and R. W. Boese (NASA Ames Research Center, Moffett Field, Calif.). *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 25, Jan. 1981, p. 25-28. Grant No. NCA2-OR-380-901.

A81-16070 * The infrared emission of G333.6-0.2 - An extremely nonspherical H II region. A. R. Hyland (Mt. Stromlo and

Siding Spring Observatory, Canberra, Australia; California Institute of Technology, Pasadena, Calif.), P. J. McGregor (Mt. Stromlo and Siding Spring Observatory, Canberra, Australia), G. Robinson, J. A. Thomas (Royal Australian Air Force Academy, Melbourne, Australia), E. E. Becklin, I. Gatley, and M. W. Werner (California Institute of Technology, Pasadena, Calif.). *Astrophysical Journal, Part 1*, vol. 241, Oct. 15, 1980, p. 709-718. 44 refs. Research supported by the Australian Research Grants Committee; Grant No. NGR-05-002-281.

The southern H II region G333.6-0.2, which has a total luminosity of 3.3 million solar luminosities (for an assumed distance of 4 kpc) was mapped at 2.2, 10, 30, 50, and 100 microns. At all wavelengths, the surface brightness of the infrared radiation is unusually high and the structure of the source is compact and symmetrical. The present observations, along with previous data, suggest that G333.6-0.2 is excited by a single luminous object or a very compact cluster, which has formed on the front surface of a dense molecular cloud as seen from the earth. It is shown that the spectral and spatial characteristics of the infrared radiation can be understood in terms of this blister model. B.J.

A81-17428 * Ion energetics in the Venus nightside ionosphere. W. C. Knudsen, K. L. Miller (Lockheed Research Laboratories, Palo Alto, Calif.), K. Spenner (Fraunhofer-Institut für physikalische Messtechnik, Freiburg im Breisgau, West Germany), and R. C. Whitten (NASA, Ames Research Center, Moffett Field, Calif.). *Geophysical Research Letters*, vol. 7, Dec. 1980, p. 1045-1048. 8 refs. Bundesministerium für Forschung und Technologie Contract No. 01-DO-238/RV14-B28/73; Contract No. NAS2-9481.

Consideration is given to the energetics of the ion gas flowing across the terminator into the Venus nightside ionosphere. Expressions are derived for the transport time of the ion gas (through 1 radian in solar zenith angle), the heat transfer time from the hot electron gas to the ions of an amount equal to the ion thermal energy), and the time required for vertical heat conduction to remove the internal energy of the ion column above a reference altitude, and it is shown that the time constant for transport is an order of magnitude smaller than the electron heat transfer time and comparable to the conduction time, and thus the ion gas is not a vertical conductive steady state. The conversion of bulk flow ion kinetic energy into heat is suggested as the mechanism responsible for the maintenance of the nightside ion temperatures at their observed values. It is thus concluded that the flow of the ion gas is quasi-adiabatic, and that steady-state, vertical, one dimensional energy balance models must be used with caution in the Venus ionosphere. A.L.W.

A81-17972 * Studies of bipolar nebulae. VI - Optical spectrophotometric mapping of GL 2688 /the Cygnus EGG Nebula/. M. Cohen (NASA, Ames Research Center, Moffett Field, Calif.) and L. V. Kuhi (California, University, Berkeley, Calif.). *Astronomical Society of the Pacific, Publications*, vol. 92, Oct.-Nov. 1980, p. 736-745. 15 refs. NSF Grants No. GP-29684; No. AST-79-02866.

Optical scanner spectra are presented for ten positions in the lobes of GL 2688. Color gradients exist across the nebulae, probably due to systematic variations in the sizes of typical scattering grains. Molecular emissions C2, C3, and SiC2 are found, similar to the spectra of comets. Resonance fluorescence seems to be indicated. (Author)

A81-18146 * # Electromagnetic heating of Io. D. S. Colburn (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 10, 1980, p. 7257-7261. 26 refs.

The electromagnetic heating of the Io interior is considered as an alternative to tidal dissipation to account for the observed volcanic activity. The characteristics of the time-varying magnetic

field of Jupiter as seen from Io are discussed, and the range of possible rock conductivities is examined. Interior heating due to the transverse electric and transverse magnetic modes is calculated. It is found that the TM mode appears to be insignificant as a heating source due to the high conductivity of the ionosphere, even when TM heating is concentrated in local hot regions. The TE mode is a more promising source of heating, although electromagnetic heating by either mode does not appear significant in comparison with other heat sources at present.

A.L.W.

A81-18171 * Absorption cross section of CF₄ at H Lyman alpha/121.57 nm/. E. C. Y. Inn (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 20, 1980, p. 7493, 7494. 6 refs.

A81-18470 * Criteria for fragmentation in a collapsing rotating cloud. P. Bodenheimer (NASA, Ames Research Center, Space Sciences Div., Moffett Field; Lick Observatory, Santa Cruz, Calif.), J. E. Tohline (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.; Yale University, New Haven, Conn.), and D. C. Black (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.). *Astrophysical Journal, Part 1*, vol. 242, Nov. 15, 1980, p. 209-218. 23 refs. Research supported by the Max-Planck-Institut für Astrophysik; NSF Grant No. AST-76-17590; Grant No. NCA2-OR660-703.

The isothermal collapse of a rotating protostar with pressure and self-gravity is calculated by a hydrodynamic computer code that treats three space dimensions. A number of initial conditions are tested to determine the conditions under which a cloud is unstable to fragmentation. It is shown that fragmentation does not proceed to a significant extent during the first free-fall time, but that in most cases fragmentation has occurred by 1.5 to 2 times the initial free-fall time. The extent to which the density in the fragments is enhanced over that in their surroundings on this time scale depends on the initial ratio of thermal to gravitational energy, but is only weakly dependent on the type and amplitude of the perturbation and on the initial rotational energy.

B.J.

A81-18520 * High angular resolution far-infrared observations of the W3 region. M. W. Werner, E. E. Becklin, I. Gatley, G. Neugebauer, K. Sellgren (California Institute of Technology, Pasadena, Calif.), H. A. Thronson, Jr. (Steward Observatory, Tucson, Ariz.), D. A. Harper, R. Loewenstein, and S. H. Moseley (Yerkes Observatory, Williams Bay, Wis.). *Astrophysical Journal, Part 1*, vol. 242, Dec. 1, 1980, p. 601-608. 39 refs. Grants No. NGR-05-003-432; No. NGR-03-002-390; No. NGR-14-001-227.

A 2 x 3 arcmin region surrounding the W3 cluster of near-infrared sources and compact H II regions has been mapped at 30, 50, and 100 microns with an angular resolution of about 30 arcsec. The data have been used to produce maps of the distribution of luminosity, color temperature, and opacity in the far-infrared which are used to analyze the properties and evolutionary states of the individual compact sources in the cluster and of the molecular cloud in which they are embedded. The total luminosity of the near-infrared source W3-IRS 5 is estimated on the basis of these observations to be 200,000 solar luminosities, and it is identified as a forming O star.

(Author)

A81-18529 * Collapse and equilibrium of rotating, adiabatic clouds. A. P. Boss (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.). *Astrophysical Journal, Part 1*, vol. 242, Dec. 1, 1980, p. 699-709. 27 refs.

A numerical hydrodynamics computer code analysis of the collapse and establishment of equilibrium of adiabatic gas clouds restricted to axial symmetry found that the clouds are originally

uniform in density and rotation. The method can compare the dynamic collapse and approach to equilibrium with the data on incompressible uniformly rotating equilibrium clouds and on equilibrium structures of differentially rotating polytropes. It is concluded that the stellar formation theory indicates that the low alpha fragments produced at the termination of the dynamic isothermal collapse phase of interstellar clouds may undergo significant dynamic collapse in an adiabatic regime leading to transitory ring formation and additional fragmentation on a smaller scale.

A.T.

A81-18531 * Stellar winds, fast rotators, and magnetic acceleration. S. Nerney (NASA, Ames Research Center, Space Sciences Div., Moffett Field; San Francisco State University, San Francisco, Calif.). *Astrophysical Journal, Part 1*, vol. 242, Dec. 1, 1980, p. 723-737. 67 refs. Grant No. NCA2-OR-660-806.

The assumption that observed mass outflow from a star is due to a magnetically driven wind implies an upper bound on the surface magnetic field strength from regions where the wind originates. Evidence is reported that corroborates Rosendhal's observation of an abrupt change in the velocity-gradient-luminosity relationship for B8 and later supergiants. The smallest upper bounds correspond to later spectral types, for which radiation would be a relatively inefficient mechanism for driving wind; these winds may in fact be magnetically driven. Be stars are prime candidates for magnetically accelerated winds due to large rotation rates and small mass loss rates. Observed flows can be driven by 0.1-10 gauss surface fields. Intense field in fast rotators can lead to dramatic mass loss rates and large terminal velocities; sigma Ori E may be such an object. Finally, the effect of magnetic acceleration on the dispersal of solar nebula is considered. The increased velocities allow the wind to disperse a mass of 90 times the initial outflowing mass in the wind.

(Author)

A81-20340 * Interstellar shock waves. C. F. McKee (California, University, Berkeley, Calif.) and D. J. Hollenbach (NASA, Ames Research Center, Moffett Field, Calif.). In: Annual review of astronomy and astrophysics. Volume 18. (A81-20334 07-90) Palo Alto, Calif., Annual Reviews, Inc., 1980, p. 219-262. 223 refs. NSF Grant No. AST-77-23069.

The structure of interstellar shocks driven by supernova remnants and by expanding H II regions around early-type stars is discussed. Jump conditions are examined, along with shock fronts; post-shock relaxation layers, collisional shocks, collisionless shocks, nonradiative shocks, radiative atomic shocks, and shock models of observed nebulae. Effects of shock waves on interstellar molecules are examined, with reference to the chemistry behind shock fronts, infrared and vibrational-rotational cooling by molecules, and observations of shocked molecules. Some current problems and applications of the study of interstellar shocks are summarized, including the initiation of star formation by radiative shock waves, interstellar masers, the stability of shocks, particle acceleration in shocks, and shocks in galactic nuclei.

F.G.M.

A81-21753 * Fragmentation in rotating isothermal protostellar clouds. P. Bodenheimer (Lick Observatory, Mount Hamilton, Calif.), J. E. Tohline (California, University, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.), and D. C. Black (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.). (*International Astronomical Union, Colloquium on Stellar Hydrodynamics, 58th, Los Alamos, N. Mex., Aug. 12-15, 1980.*) *Space Science Reviews*, vol. 27, Nov.-Dec. 1980, p. 247-252; Discussion, p. 253. 7 refs.

The paper reports results of an extensive set of three-dimensional hydrodynamic calculations performed to investigate the susceptibility of rotating clouds to gravitational fragmentation; only isothermal collapse sequences were considered. It is found that rotating isothermal gas clouds are unstable to fragmentation under a wide range of conditions. The degree of instability and the mode

(ring vs. blob) of fragmentation is sensitive to alpha, but insensitive to beta. The initial amplitude of a perturbation does not appear to be crucial; fragmentation should occur eventually even for low-amplitude initial NAPs. B.J.

A81-21754 * **Collapse, equilibrium, and fragmentation of rotating, adiabatic clouds.** A. P. Boss (NASA, Ames Research Center, Moffett Field, Calif.). (*International Astronomical Union, Colloquium on Stellar Hydrodynamics, 58th, Los Alamos, N. Mex., Aug. 12-15, 1980.*) *Space Science Reviews*, vol. 27, Nov.-Dec. 1980, p. 255-259; Discussion, p. 259. 13 refs.

Numerical calculations of the collapse of adiabatic clouds from uniform density and rotation initial conditions show that when restricted to axisymmetry, the clouds form either near-equilibrium spheroids or rings. Rings form in the collapse of low thermal energy clouds and have a ratio of rotational kinetic energy to the absolute value of gravitational potential energy greater than approximately 0.43. When the axisymmetric constraint is removed and an initial $m = 2$ density variation is introduced, clouds either collapse to form near-equilibrium ellipsoids or else fragment into binary systems through a bar phase. Ellipsoids form in the collapse of high thermal energy clouds and have a rotational kinetic energy/absolute value of gravitational potential energy ratio less than approximately 0.27. The results are consistent with the critical values of the rotational kinetic energy/absolute value of gravitational potential energy ratio for instabilities in Maclaurin spheroids, and suggest that protostellar clouds may undergo a dynamic fragmentation in the nonisothermal collapse regime. (Author)

A81-21787 * **The effect of rotation on the hydrodynamics of stellar collapse.** J. E. Tohline (California, University, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.), J. M. Schombert (Yale University Observatory, New Haven, Conn.), and A. P. Boss (NASA, Ames Research Center, Moffett Field, Calif.). (*International Astronomical Union, Colloquium on Stellar Hydrodynamics, 58th, Los Alamos, N. Mex., Aug. 12-15, 1980.*) *Space Science Reviews*, vol. 27, Nov.-Dec. 1980, p. 555-560; Discussion, p. 561. 16 refs.

A81-21929 * # **Temperature dependence of HNO₃ absorption in the 11.3-micron region.** A. Goldman, F. S. Bonomo (Denver, University, Denver, Colo.), F. P. J. Valero, D. Goorvitch, and R. W. Boese (NASA, Ames Research Center, Astrophysical Experimental Branch, Moffett Field, Calif.). *Applied Optics*, vol. 20, Jan. 15, 1981, p. 172-175. 5 refs. Grants No. NCA2-OR-205-901; No. NOAA-NA-79AAD00021.

Laboratory spectra have been obtained for HNO₃ with a Michelson-type Fourier transform interferometer using absorption cells with path lengths of 10.3, 25.5, and 49.8 cm at temperatures of 240, 248, 283, and 294 K. The measurements lead to a total band intensity value of 642 plus or minus 5% per sq cm amagat, which is a temperature independent value after the gas density correction has been made. However, the temperature dependence of the spectral absorption coefficients is apparent in the 885 kayser region. V.L.

A81-22196 * **In quest of telescopes.** M. Cohen (NASA, Ames Research Center, Moffett Field, Calif.). *Sky and Telescope*, vol. 61, Feb. 1981, p. 116-119.

This article deals with the author's decision to study star formation and reviews the early days of infrared astronomy at O'Brien Observatory. The infrared equipment used to observe the T Tauri variable class is described. L.S.

A81-22537 * **A model of temporal variations in ozone density in the Martian atmosphere.** T. Shimazaki (NASA, Ames Research Center, Moffett Field, Calif.). *Planetary and Space Science*, vol. 29, Jan. 1981, p. 21-33. 30 refs.

Temporal variations of the ozone density profile in the Martian atmosphere at high latitudes are calculated for the course of a Martian year, taking into account seasonal and diurnal variations in temperature, water vapor and solar radiation. Calculations are based on a model including 35 neutral photochemical reactions, and vertical eddy diffusion using a time step of 12 min for the region from the surface to 240 km altitude. Results are found to be in better agreement with Mariner 9 observations of the time and magnitude of the seasonal maximum than previous model calculations. The diurnal variation is predicted to be small near the solstices, with the nighttime ozone density greater than the daytime and the magnitude of the difference dependent on season. Opposite temporal variations are predicted for ozone densities above and below about 25 km, and an ozone density maximum at 35-40 km is obtained. It is suggested that the effects of an aerosol layer may not be important in enhancing predicted ozone concentration, and may even decrease it. A.L.W.

A81-22777 * **A physical model of Titan's clouds.** O. B. Toon, J. B. Pollack (NASA, Ames Research Center, Space Science Div., Moffett Field, Calif.), and R. P. Turco (R & D Associates, Marina del Rey, Calif.). *Icarus*, vol. 43, Sept. 1980, p. 260-282. 37 refs.

A physical model of the formation and growth of aerosols in the atmosphere of Titan has been constructed in light of the observed correlation between variations in Titan's albedo and the sunspot cycle. The model was developed to fit spectral observations of deep methane bands, pressures, temperature distributions, and cloud structure, and is based on a one-dimensional physical-chemical model developed to simulate the earth's stratospheric aerosol layer. Sensitivity tests reveal the model parameters to be relatively insensitive to particle shape but sensitive to particle density, with high particle densities requiring larger aerosol mass production rates to produce compatible clouds. Solution of the aerosol continuity equations for particles of sizes 13 Å to about 3 microns indicates the importance of a warm upper atmosphere and a high-altitude mass injection layer, and the production of aerosols at very low aerosol optical depths. Limits are obtained for the chemical production of aerosol mass and the eddy diffusion coefficient, and it is found that an increase in mass input causes a decrease in mean particle size. A.L.W.

A81-22780 * **On the detection of other planetary systems - Detection of intrinsic thermal radiation.** D. C. Black (NASA, Ames Research Center, Space Science Div., Moffett Field, Calif.). *Icarus*, vol. 43, Sept. 1980, p. 293-301. 19 refs.

There is currently no unambiguous observational evidence for the existence of other planetary systems. One possible way to detect and study such systems is infrared observations of continuum blackbody radiation from planets revolving around other stars. It is shown that the effective temperature of large planets revolving around mid- to late-spectral-type main-sequences stars is set by energy sources internal to the planet rather than by equilibrium with the radiation field of the central star, making them easier to detect than had been previously thought. Consideration is given to the two major observational constraints on detecting planetary companions to nearby stars, namely, angular resolution and sensitivity. A comparison is made between the performance of an ambient (T 200 K), single-aperture telescope and a cooled interferometer. In each case the required aperture (baseline) is large (in the 10-m class), but consistent with Shuttle launch capability. (Author)

A81-22940 * **Measurements of the volcanic plumes of Mount St. Helens in the stratosphere and troposphere - Introduction.** J. B. Pollack (NASA, Ames Research Center, Moffett Field, Calif.). *Science*, vol. 211, Feb. 20, 1981, p. 815, 816. 19 refs. NASA-sponsored research.

A81-22942 * Trajectories of the Mount St. Helens eruption plume. E. F. Danielsen (NASA, Ames Research Center, Moffett Field, Calif.). *Science*, vol. 211, Feb. 20, 1981, p. 819-821.

The plume of the major eruption of Mount St. Helens on May 18, 1980 penetrated 10 to 11 km into the stratosphere, attaining heights of 22 to 23 km. Wind shears rapidly converted the plume from an expanding vertical cone to a thin, slightly inclined lamina. The lamina was extruded zonally in the stratosphere as the lower part moved eastward at jet stream velocities, while the upper part slowly moved westward in the region of nonsteady transition from the westerlies to the summer stratospheric easterlies. Trajectories computed to position the NASA U-2 aircraft for sampling in the plume are described. Plume volume after 8 hours of strong volcanic emission is estimated at 2,000,000 cu km. Only about 1% of this volume is attributed to the volcano; the rest was entrained from the environment. (Author)

A81-22943 * Gaseous constituents in the plume from eruptions of Mount St. Helens. E. C. Y. Inn, J. F. Vedder, E. P. Condon (NASA, Ames Research Center, Moffett Field, Calif.), and D. O'Hara (LFE Corp., Richmond, Calif.). *Science*, vol. 211, Feb. 20, 1981, p. 821-823. 8 refs.

Measurements in the stratosphere of gaseous constituents in the plume of Mount St. Helens were obtained during five flights of the NASA U-2 aircraft between 19 May and 17 June 1980. Mixing ratios from gas chromatographic measurements on samples acquired about 24 hours after the initial eruption show considerable enhancement over nonvolcanic concentrations for sulfur dioxide (more than 1000 times), methyl chloride (about 10 times), and carbon disulfide (more than 3 times). The mixing ratio of carbonyl sulfide was comparable to nonvolcanic mixing ratios although 3 days later it was enhanced two to three times. Ion chromatography measurements on water-soluble constituents are also reported. Very large concentrations of chloride, nitrate, and sulfate ions were measured, implying large mixing ratios for the water-soluble gaseous constituents from which the anions are derived. Measurements of radon-222 present in the plume are also reported. (Author)

A81-22948 * Size distributions and mineralogy of ash particles in the stratosphere from eruptions of Mount St. Helens. N. H. Farlow, V. R. Oberbeck, K. G. Snetsinger, G. V. Ferry (NASA, Ames Research Center, Moffett Field, Calif.), G. Polkowski, and D. M. Hayes (LFE Corp., Richmond, Calif.). *Science*, vol. 211, Feb. 20, 1981, p. 832-834. 9 refs.

Samples from the stratosphere obtained by U-2 aircraft after the first three major eruptions of Mount St. Helens contained large globules of liquid acid and ash. Because of their large size, these globules had disappeared from the lower stratosphere by late June 1980, leaving behind only smaller acid droplets. Particle size distributions and mineralogy of the stratospheric ash grains demonstrate inhomogeneity in the eruption clouds. (Author)

A81-23061 * Investigation of the 1-0 pressure-induced vibrational absorption spectrum of hydrogen at temperatures below ambient. D. Goorvitch, P. M. Silvaggio, and R. W. Boese (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 25, Mar. 1981, p. 237-248. 22 refs.

A theoretical fit has been made to laboratory measurements of the 1-0 collisionally induced H₂ absorption band over a temperature range of 100-273 K and for densities up to 22 amagats. Both the Birnbaum-Cohen and the MacTaggart-Hunt line shape profiles were used. In addition, an intermolecular potential of either a Lennard-Jones 6-12 or a Morse-spline-van der Waals has been used for each line shape. The best fit resulted in a chi-square of 5%. Line widths have also been derived as a function of temperature. The lifetimes of the states were calculated. (Author)

A81-23104 * A study of stratospheric aerosol maturity. V. R. Oberbeck, N. H. Farlow, G. V. Ferry (NASA, Ames Research Center, Moffett Field, Calif.), H. Y. Lem, and D. M. Hayes (LFE Corp., Environmental Analysis Laboratories, Richmond, Calif.). *Geophysical Research Letters*, vol. 8, Jan. 1981, p. 18-20. 7 refs.

A sampling and analysis technique that uses the binomial distribution to characterize stratospheric aerosol populations at the 95% level of confidence is described. Particle samples obtained over Alaska during July 15-19, 1979, are used; the results show the presence of more small particles at lower altitude than at high altitudes. Calculations of the surface area and volume distributions for all aerosol samples collected are given. Evidence from these data suggests either that Aitken nuclei are injected or diffused across the tropopause and rise into the stratosphere, where they mature into larger particles, or nuclei form in the lower stratosphere and become mature aerosols at high altitude. Samples obtained at another site give the same results, supporting the view that the process of injection or nucleation and maturing of aerosols with altitude may be global and need not occur only in locations exhibiting unique meteorologic features. (Author)

A81-23106 * Implications of stratospheric aerosol measurements for models of aerosol formation and evolution. O. B. Toon, R. Whitten (NASA, Ames Research Center, Moffett Field, Calif.), R. P. Turco (R & D Associates, Marina del Rey, Calif.), and P. Hamill (SAS Corp., Palo Alto, Calif.). *Geophysical Research Letters*, vol. 8, Jan. 1981, p. 23-25. 17 refs.

Calculations of the distribution of stratospheric sulfur gases and of stratospheric aerosols are compared with measurements obtained in Alaska during July 1979. Generally, the measurements are reasonably consistent with the model results. COS is the major sulfur-bearing gas in the stratosphere while CS₂ plays a lesser role in the formation of sulfate aerosols. Ammonia, which earlier measurements suggested was a major aerosol constituent, is found to be a contaminant, so models without ammonia chemistry may be justified. The model and the measurements suggest that stratospheric sulfuric acid aerosols nucleate just above the tropopause, but they are older and have grown to larger sizes at higher altitudes. (Author)

A81-23107 * Radiative properties of the background stratospheric aerosols and implications for perturbed conditions. J. R. Pollack, O. B. Toon (NASA, Ames Research Center, Space Science Div., Moffett Field, Calif.), and D. Wiedman (Informatics, Inc., Palo Alto, Calif.). *Geophysical Research Letters*, vol. 8, Jan. 1981, p. 26-28. 22 refs.

A series of Mie scattering calculations has been performed to define the wavelength-dependent, single scattering properties of aerosols present in the stratosphere during July 1979. Additional radiative transfer computations were conducted to assess the impact of aerosols on the earth's radiation budget. For these purposes, an extensive set of measurements of aerosol characteristics that were obtained in Alaska from aircraft and satellite platforms was used. At that time, the optical depth was too small for aerosols to significantly impact earth's climate. But the optical depth of the stratospheric aerosol layer has been large enough during some volcanically perturbed periods for the aerosols to have caused a noticeable warming of the stratosphere and cooling of the troposphere. (Author)

A81-24453 * Stratospheric hydroxyl radical concentrations - New limitations suggested by observations of gaseous and particulate sulfur. R. P. Turco (R & D Associates, Marina del Rey, Calif.), R. C. Whitten, O. B. Toon, E. C. Y. Inn (NASA, Ames Research Center, Moffett Field, Calif.), and P. Hamill (Systems and Applied Sciences Corp., Hampton, Va.). *Journal of Geophysical Research*, vol. 86, Feb. 20, 1981, p. 1129-1139. 71 refs. Contract No. NAS2-9881.

A one-dimensional aerosol model is employed in investigating the sensitivity of the stratospheric distributions of gaseous sulfur compounds and sulfate aerosol particles to changes in OH and CS₂ concentrations, in eddy diffusion coefficients, and in important chemical rate constants. By comparing model predictions with recent observational data for SO₂, OCS, and particulates, it is found that, with regard to atmospheric sulfur, CS₂ is only a secondary source of sulfur for the stratosphere relative to OCS and that background tropospheric CS₂ concentrations by volume are likely to be less than 70 parts per trillion. It is also established that under stratospheric conditions the rate coefficients for the reactions of OH with OCS and CS₂ may be substantially smaller than the room temperature laboratory values of Kurylo (1978). C.R.

A81-24456 * **Measurements of nitric oxide after a nuclear burst.** M. McGhan (NASA, Ames Research Center, Moffett Field, Calif.; Utah State University of Agriculture and Applied Science, Logan, Utah), A. Shaw, L. R. Megill (Utah State University of Agriculture and Applied Science, Logan, Utah), W. Sedlacek, P. R. Guthals, and M. M. Fowler (California, University, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.). *Journal of Geophysical Research*, vol. 86, Feb. 20, 1981, p. 1167-1173. 18 refs. NOAA-supported research; NSF Grant No. ATM-77-701869.

Measurements of ozone and nitric oxide in a nuclear cloud 7 days after the explosion are reported. No measurable increase above ambient density of either ozone or nitric oxide was found. Results from a chemistry model of the cloud do not agree with the measurement unless 'nonstandard' assumptions are made with regard to the operating chemical processes. A number of possible explanations of the results are discussed. (Author)

A81-24458 * **Improved airborne measurements of OH in the atmosphere using the technique of laser-induced fluorescence.** C. C. Wang, L. I. Davis, Jr., P. M. Selzer (Ford Motor Co., Dearborn, Mich.), and R. Munoz (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 86, Feb. 20, 1981, p. 1181-1186. 27 refs. Research supported by the U.S. Department of Energy, NASA, and NSF.

A81-26260 * **Detection of a CH₄ atmosphere on Pluto.** U. Fink, B. A. Smith, J. R. Johnson, H. J. Reitsema (Arizona, University, Tucson, Ariz.), D. C. Benner (NASA, Ames Research Center, Astrophysical Experiments Branch, Moffett Field, Calif.; Arizona, University, Tucson, Ariz.), and J. A. Westphal (Hale Observatories, Pasadena, Calif.). *Icarus*, vol. 44, Oct. 1980, p. 62-71. 28 refs. Grants No. NSG-7070; No. NGL-05-002-003; Contract No. NAS5-25451.

A ratio spectrum of Pluto shows methane absorption bands at 6200, 7200, 7900, 8400, 8600, 8900, and 10,000 Å. The heavy saturation of the 8900 band as compared to the other bands indicates a gaseous origin for the observed absorptions. A total methane abundance of 80 ± 20 m-am is derived, and an upper limit to the total pressure of approximately .05 atm is set. The methane atmosphere would be stable if the mass of Pluto is increased 50% over its present value and its radius is 1400 km. A heavier gas mixed with the methane atmosphere would also aid its stability. L.S.

A81-26261 * **Cosmic ray synthesis of organic molecules in Titan's atmosphere.** L. A. Capone (San Jose State University, San Jose, Calif.), J. Dubach (California, University, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.), R. C. Whitten (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.), S. S. Prasad (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and K. Santhanam (Informatics, Inc., Palo Alto,

Calif.). *Icarus*, vol. 44, Oct. 1980, p. 72-84. 48 refs. Grant No. NSG-2130.

The possible synthesis of organic molecules by the absorption of galactic cosmic rays in an N₂-CH₄-H₂ Titan model atmosphere has been studied. The cosmic-ray-induced ionization results in peak electron densities of 2000/cm, with NH(+), C₃H₉(+), and C₄H₉(+) being among the important positive ions. Details of the ion and neutral chemistry relevant to the production of organic molecules are discussed. The potential importance of N(2D) reactions with CH₄ and H₂ is also demonstrated. Although the integrated production rate of organic matter due to the absorption of the cosmic ray cascade is much less than that by solar ultraviolet radiation, the production of nitrogen-bearing organic molecules by cosmic rays may be greater. (Author)

A81-26776 * # **The Pioneer Venus program.** L. Colin (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 7575-7598. 151 refs.

The major aspects of the Pioneer Venus orbiter and multiprobe missions are documented. Specific topics covered include a program history, the scientific payloads, spacecraft descriptions, launch and interplanetary cruise features, encounter features, nominal mission descriptions, instrument anomalies, and the orbiter extended mission. The key scientific questions addressed by the missions are listed. L.S.

A81-26778 * # **Pioneer Venus plasma observations of the solar wind-Venus interaction.** J. D. Mihalov, J. H. Wolfe (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.), and D. S. Intriligator (Southern California, University, Los Angeles, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 7613-7624. 48 refs.

Collection of data from the Ames plasma analyzer on the Pioneer Venus orbiter has permitted long-term measurements of the interaction of the solar wind with Venus. The paper presents a mapping of the ionosheath flow field, plasma measurements in the distant ionosheath and near the distant plasma cavity, and a summary of observations of jumps in the solar wind proton parameters across Venus' bow shock. Also, the apparent detection of ionospheric O(+) accelerated up to solar wind speeds downstream in Venus' ionosheath is discussed. (Author)

A81-26789 * **Suprathermal electron energy distribution within the dayside Venus ionosphere.** W. C. Knudsen, K. L. Miller (Lockheed Research Laboratories, Palo Alto, Calif.), K. Spennner, V. Novak (Fraunhofer-Institut für physikalische Messtechnik, Freiburg im Breisgau, West Germany), P. F. Michelson (Stanford University, Stanford, Calif.), and R. C. Whitten (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 7754-7758. 19 refs. Bundesministerium für Forschung und Technologie Contract No. 01-DO-238/RV14-B28/73; Contract No. NAS2-9481.

The suprathermal electron energy distribution for the dayside ionosphere has been derived from data returned by the Pioneer-Venus orbiter retarding potential analyzer. The shape and magnitude of the spectrum are consistent with the assumption that solar EUV radiation is the only significant source. The magnitude of the spectrum and its variation with altitude suggest that significant vertical transport occurs, with the electrons being lost through the ionopause. In turn, significant vertical transport suggests that the effective vertical electron heat conductivity may be comparable to the field-free value. The heat input to the thermal electron gas from the measured suprathermal electron flux is too small by a factor of at least five to maintain the observed electron temperature profile if the electron thermal conductivity is assumed to be close to the field-free value. It is thus inferred that most of the heat is supplied by the solar wind. (Author)

A81-26790 * **Solar zenith angle dependence of ionospheric ion and electron temperatures and density on Venus.** K. L. Miller, W. C. Knudsen (Lockheed Research Laboratories, Palo Alto, Calif.), K. Spenner, V. Novak (Fraunhofer-Institut für physikalische Messtechnik, Freiburg im Breisgau, West Germany), and R. C. Whitten (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 7759-7764. 25 refs. Bundesministerium für Forschung und Technologie Contract No. 01-DO-238/RV14-1328/73; Contract No. NAS2-9481.

The measurements taken during the first year of the Pioneer Venus orbiter retarding potential analyzer indicate the changes of ion and electron temperatures with solar zenith angles. The ion density decreases by an order of magnitude from dayside to nightside; median ion temperatures above 300 km are constant with the solar zenith angle below 150 deg and reach 2300 K at the ionopause. The ion temperatures below 300 km are almost constant with solar zenith angles during the dayside, but increase with the angles on the nightside. The electron temperatures suggest a constant heat flux into the electron gas at the ionopause which may be supplied by dissipation of energy by the whistler mode plasma waves at the ionopause and/or conduction of heat from the ionosheath through the mantle. A.T.

A81-26805 * # **Measurements of thermal structure and thermal contrasts in the atmosphere of Venus and related dynamical observations - Results from the four Pioneer Venus probes.** A. Seiff, D. B. Kirk, R. E. Young, S. C. Sommer (NASA, Ames Research Center, Moffett Field, Calif.), R. C. Blanchard (NASA, Langley Research Center, Hampton, Va.), J. T. Findlay, and G. M. Kelly (Analytical Mechanics Associates, Inc., Hampton, Va.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 7903-7933. 45 refs.

The thermal structure of the Venus atmosphere and differences in structure with latitude (up to 60 deg) and clock hour (from midnight to 8 AM) have been measured in situ from a height of 126 km to the surface by instruments on the four Pioneer Venus entry probes. It is found that thermal contrasts below 45 km are a few K, with the midlatitudes warmer than both equatorial and high latitudes. Considerable temperature and pressure differences with latitude develop in the clouds (25 K and 20 mbar level). In addition, upward of 110 km, there is evidence of large-amplitude temperature oscillations with altitude, believed to signify the presence of large-amplitude waves, perhaps thermal tides. Agreement of structure data from other Pioneer Venus experiments is generally excellent. B.J.

A81-26810 * **Structure and circulation of the Venus atmosphere.** G. Schubert, C. Covey (California, University, Los Angeles, Calif.), A. Del Genio (NASA, Goddard Institute for Space Studies, New York, N.Y.), L. S. Elson, J. Apt, A. J. Kliore (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), G. Keating (NASA, Langley Research Center, Hampton, Va.), A. Seiff, R. E. Young (NASA, Ames Research Center, Moffett Field, Calif.), and C. C. Counselman, III (MIT, Cambridge, Mass.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 8007-8025. 95 refs.

The Pioneer Venus data relevant to the dynamics and thermodynamics of the atmosphere is summarized and interpreted. On the day side there is a thermosphere in which temperatures increase with height to an exospheric temperature of about 300 K. On the night side there is a cryosphere in which temperatures decrease with height to an exospheric temperature of about 100 K. The atmosphere is stratified stably from the highest altitudes down to about 28 km except for a layer in the clouds between about 50 and 55 km which is nearly adiabatic. Horizontal thermal contrasts are approximately 1 to 2% in the deep atmosphere and 100% in the upper atmosphere. The temperatures generally decrease with latitude at and below the clouds on constant pressure surfaces. Above the clouds there is a reversed zonally averaged latitudinal temperature gradient. The dominant circulation of the atmosphere above the lowest one or two

scale heights is a zonal retrograde motion with 100 m/s winds at 60 km altitude. There is also a superrotation at altitudes of 150 km and above. L.S.

A81-26814 * **The clouds of Venus - A synthesis report.** R. Knollenberg (Particle Measuring Systems, Inc., Boulder, Colo.), L. Travis (NASA, Goddard Institute for Space Studies, New York, N.Y.), M. Tomasko, P. Smith (Arizona, University, Tucson, Ariz.), B. Ragert (NASA, Ames Research Center, Moffett Field, Calif.), L. Esposito (Colorado, University, Boulder, Colo.), D. McCleese, J. Martonchik, and R. Beer (California Institute of Technology, Jet Propulsion Laboratory, Planetary Atmospheres Section, Pasadena, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 8059-8081. 55 refs.

The results presented represent a synthesis of data from those Pioneer Venus experiments directed toward studying cloud problems. These orbiter and multiprobe experiments show the cloud system to consist of three altitude regions populated by cloud particles and smaller haze particles which extend above and below as well as coexist with the cloud particles. The optical properties derived are only consistent with the largest particles, having platelike morphology. The smallest particles are shown to require changes in chemical composition to explain observed behavior. The medium-sized H₂SO₄ droplets of 2 micrometers diameter appear to be the least volatile and are the best understood. The role of the cloud particles in precipitation dynamical processes, lightning, and radiation are all discussed. (Author)

A81-26816 * **The structure of the clouds of Venus - Results of the Pioneer Venus nephelometer experiment.** B. Ragert (NASA, Ames Research Center, Moffett Field, Calif.) and J. Blamont (CNRS, Service d'Aéronomie, Verrières-le-Buisson, Essonne, France). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 8089-8105. 49 refs.

The nephelometer measurements by the four Pioneer Venus probes reveal an upper haze area in the vertical cloud structure with several less clearly delineated layers in the main cloud bank. Concentrated sulfuric acid is the main component of the majority of the particulate matter in the clouds; the near UV radiation is absorbed by the clouds. The particles ejected from the planet surface are in the 10 to 100 micron range. A.T.

A81-26819 * # **Distribution and source of the UV absorption in Venus' atmosphere.** J. B. Pollack, O. B. Toon, R. C. Whitten, R. Boese, B. Ragert (NASA, Ames Research Center, Moffett Field, Calif.), M. Tomasko (Arizona, University, Tucson, Ariz.), L. Esposito (Colorado, University, Denver, Colo.), L. Travis (NASA, Goddard Institute for Space Studies, New York, N.Y.), and D. Wiedman (Informatics, Inc., Palo Alto, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 8141-8150. 39 refs.

The model predictions were compared with the Pioneer Venus probes and orbiter to determine the composition of the UV absorbing materials. The simulations were carried out with radiative transfer codes which included spacecraft constraints on the aerosol and gas characteristics in the Venus atmosphere; gaseous SO₂ (a source of opacity at the wavelengths below 0.32 microns), and a second absorber (which dominates above 0.32 microns) were required. The UV contrast variations are due to the optical depth changes in the upper haze layer producing brightness variations between equatorial and polar areas, and to differences in the depth over which the second UV absorber is depleted in the highest portion of the main clouds. A.T.

A81-26823 * **The thermal balance of Venus in light of the Pioneer Venus mission.** M. G. Tomasko, P. H. Smith (Arizona, University, Tucson, Ariz.), V. E. Suomi, L. A. Sromovsky, H. E.

Revercomb (Wisconsin, University, Madison, Wis.), F. W. Taylor (Oxford University, Oxford, England), D. J. Martonchik (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), A. Seiff, R. Boese, and J. B. Pollack (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 8187-8199. 61 refs.

Pioneer Venus orbiter and probes measured many of the properties of the Venus atmosphere which control its thermal balance and support its high surface temperature. Estimates based on orbiter data yield an effective radiating temperature of Venus of 228 ± 5 K, corresponding to a solar emission of 153 ± 13 W/sq cm. A mode of submicron particles is suggested as an important source of thermal opacity near the cloud tops to explain the orbiter and probe thermal flux measurements. A comparison of the measured solar flux profile with thermal fluxes computed from the measured temperature structure and composition shows that the greenhouse mechanism explains essentially all of the 500-K difference between the surface and radiating temperatures of Venus. B.J.

A81-26826 * # Greenhouse models of Venus' high surface temperature, as constrained by Pioneer Venus measurements. J. B. Pollack, O. B. Toon, and R. Boese (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 8223-8231. 41 refs.

Recent measurements conducted from the Pioneer Venus probes and orbiter have provided a significantly improved definition of the solar net flux profile, the gaseous composition, temperature structure, and cloud properties of Venus' lower atmosphere. Using these data, we have carried out a series of one-dimensional radiative-convective equilibrium calculations to determine the viability of the greenhouse model of Venus' high surface temperature and to assess the chief contributors to the greenhouse effect. New sources of infrared opacity include the permitted transitions of SO₂, CO, and HCl as well as opacity due to several pressure-induced transitions of CO₂. We find that the observed surface temperature and lapse rate structure of the lower atmosphere can be reproduced quite closely with a greenhouse model that contains the water vapor abundance reported by the Venera spectrophotometer experiment. Thus the greenhouse effect can account for essentially all of Venus' high surface temperature. The prime sources of infrared opacity are, in order of importance, CO₂, H₂O, cloud particles, and SO₂, with CO and HCl playing very minor roles. (Author)

A81-28526 * A Martian general circulation experiment with large topography. J. B. Pollack (NASA, Ames Research Center, Mountain View, Calif.), C. B. Leovy (Washington, University, Seattle, Wash.), P. W. Greiman (Florida State University, Tallahassee, Fla.), and Y. Mintz (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, Md.). *Journal of the Atmospheric Sciences*, vol. 38, Jan. 1981, p. 3-29. 42 refs. NASA-supported research.

A three-layer general circulation model of the Martian atmosphere is described, and the assumptions governing the model are discussed. The simulated, zonally averaged circulation is found to have only limited sensitivity to differences between this model and an earlier general circulation model; this circulation compares reasonably well with observations. It is also found that the meridional mass flow produced by the seasonal condensation of CO₂ in the winter polar region has a major influence on the circulation; owing to the weak influence of atmospheric heat transport, however, the mass flow is governed almost entirely by radiation. Quasi-barotropic stationary waves, which are forced kinematically by the topography and which resemble topographically forced terrestrial planetary waves, are generated by the model in the winter hemisphere region of strong eastward flow, while baroclinic stationary waves are thermally forced by topography in the tropics and summer subtropics. It is also concluded that transient baroclinically unstable waves, of somewhat lower dominant wavenumber than those found on the earth, are generated in winter midlatitudes; their amplitudes,

wavenumbers, and phase speeds closely agree with what has been deduced from the Viking lander observations. C.R.

A81-29155 * Collapses of stellar protogalaxies from aspheric initial conditions. R. H. Miller (Chicago, University, Chicago, Ill.) and B. F. Smith (NASA, Ames Research Center, Theoretical and Planetary Studies Branch, Moffett Field, Calif.). *Astrophysical Journal, Part 1*, vol. 244, Feb. 15, 1981, p. 33-39. 18 refs. NSF Grant No. AST-76-14289; Grant No. NCA2-OR-108-902.

Numerical experiments are presented which were intended to verify the independence of bar formation in rotating galaxy models from special initial conditions. Three-dimensional n-body programs were run starting from aspherical initial conditions characterized by particle rotational and peculiar velocities and offsets from sphericity for a set of 100,000 particles. All the initial configurations examined are observed to collapse to a thin form, overshoot, collapse again and again overshoot, with diameters and central densities similar to those observed under spheric initial conditions. Every aspheric collapse is also found to result in bar formation within two rotation periods, which is even sooner than in initially spherical conditions. In the intermediate stages of collapse, transient sheet patterns are found to be destroyed at asymmetries of 2-3%, while transient rings survived asymmetries of 6-7% but not 15-18%. It is noted that the results may be applicable to galaxy formation in the early universe, and possible mechanisms for the arresting of protogalactic collapse are indicated. A.L.W.

A81-31060 * Numerical experiments on galaxy formation. I

- **Introduction and first results.** R. H. Miller (Chicago, University, Chicago, Ill.) and B. F. Smith (NASA, Ames Research Center, Theoretical and Planetary Studies Branch, Moffett Field, Calif.). *Astrophysical Journal, Part 1*, vol. 244, Mar. 1, 1981, p. 467-475. 21 refs. NSF Grant No. AST-76-14289; Grant No. NCA2-OR-108-902.

The large, fully three-dimensional n-body programs designed for numerical experiments on the dynamics of galaxies have been used for investigations of protogalactic collapses. The dynamical aspects of galaxy formation dominate in this approach. The present experiments start from a large rotating gaseous mass that is made up of many gas clouds. The large mass collapses because it is out of equilibrium. Stars form as the collapse proceeds. The problem is formulated, limiting-case examples are described, and results from simple 'first cut' models are given. Results with no star formation are contrasted with results for very rapid star formation. All models with gas formed thin disklike structures; some were circular, while others were oval. The principal result from the simple models is that stars continue to form rapidly even after the gas has been depleted to unacceptably low levels (1% of the galactic mass in gas). (Author)

A81-32603 * Io - Energy constraints and plume volcanism.

R. T. Reynolds, P. Cassen (NASA, Ames Research Center, Theoretical and Planetary Studies Branch, Moffett Field, Calif.), and S. J. Peale (Joint Institute for Laboratory Astrophysics, Boulder, Colo.; California, University, Santa Barbara, Calif.). (*IAU, American Astronomical Society, COSPAR, University of Hawaii, and NASA, Colloquium on the Satellites of Jupiter, 5th, Kailua, Hawaii, May 13-16, 1980.*) *Icarus*, vol. 44, Nov. 1980, p. 234-239. 27 refs. Grants No. NGR-05-010-062; No. NCA2-OR-680-805.

Observational and theoretical considerations, including near-surface energy constraints, suggest a model of Io that features a surface layer of sulfur overlying an active silicate crust. Such a model would imply frequent contact between silicate magma intrusions and the sulfur layer. This contact could produce volcanic plumes driven by high-temperature sulfur vapor. Plumes driven by sulfur vapor meet observational constraints for a wide range of possible conditions, in contrast to the special conditions required for plume generation by SO₂. Characteristics of the two models are compared, and it is suggested that high-spatial-resolution infrared radiometry could identify the driving volatile. (Author)

A81-32613 * Physical processes in Jupiter's ring - Clues to its origin by Jove. J. A. Burns, M. R. Showalter (Cornell University, Ithaca, N.Y.), J. N. Cuzzi, and J. B. Pollack (NASA, Ames Research Center, Moffett Field, Calif.). (IAU, American Astronomical Society, COSPAR, University of Hawaii, and NASA, Colloquium on the Satellites of Jupiter, 5th, Kailua, Hawaii, May 13-16, 1980.) *Icarus*, vol. 44, Nov. 1980, p. 339-360. 78 refs. Grants No. NCA2-OR-175-001; No. NSG-7593.

It is shown that many of the observed properties of the Jovian ring can be explained by the presence of numerous small and unseen parent bodies, or 'moons', residing within the ring; whose radii are less than 1 km. The small visible ring grains, which are destroyed in short times by sputtering and meteoroid erosion, are derived from these parent bodies largely through meteoroid impacts, and partly from Io's dust. Substantial orbit modification results from plasma drag, and the charge carried by the grains will influence their dynamics and may modify their shapes. It is concluded that the processes discussed, though present in other planetary ring systems, may be highlighted in Jupiter's ring because of its low optical depth and the small size of some of its particles. It is suggested that hidden reservoirs similar to the Jovian 'moons' proposed may be present in the rings of Saturn and Uranus. O.C.

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A81-34889 * Continuing changes in the peculiar nebulous object PV Cephei. M. Cohen (NASA, Ames Research Center, Moffett Field, Calif.), L. V. Kuhi, H. Spinrad (California, University, Berkeley, Calif.), and E. A. Harlan (Lick Observatory, Santa Cruz, Calif.). *Astrophysical Journal, Part 1*, vol. 245, May 1, 1981, p. 920-926. 12 refs. NSF Grant No. 76-02866.

Changes in the nebular structure, optical spectrum and stellar brightness of the faint star PV Cephei and the nebulosity associated with it are discussed. Iris photometry of the starlike object at the tip of the fan-shaped nebula reveals irregular variability of approximately 4 magnitudes in the red. Stellar spectra in the region 4300-6750 Å taken from December 1976 to April 1980 are similar to the richest emission line spectra of T Tauri stars, while nebular spectra indicate a lack of spherical symmetry. Observations obtained in the infrared reveal a source offset by a few arcsec from the apex of the fan, which is identified with the illuminating star. Radial velocities of CO emission indicate that PV Cep is at the same distance as NGC 7023, and independent estimates lead to an estimated value of 500 pc. Such a distance corresponds to a bolometric luminosity approximately 100 times that of the sun. It is suggested that PV Cep is a T Tauri star that has recently broken through its circumstellar cocoon at a time when highly erratic variability and a strong stellar wind characterize the star. A.L.W.

A81-35188 * Temperatures of galactic molecular clouds showing CO self-absorption. T. G. Phillips, G. R. Knapp, P. G. Wannier (Owens Valley Radio Observatory, Pasadena, Calif.), P. J. Huggins (New York University, New York, N.Y.), M. W. Werner (NASA, Ames Research Center, Moffett Field, Calif.), G. Neugebauer, and D. Ennis (Palomar Observatory, Pasadena, Calif.). *Astrophysical Journal, Part 1*, vol. 245, Apr. 15, 1981, p. 512-528. 37 refs. NSF Grant No. AST-79-16815; Grant No. NGL-05-002-207.

The CO J = 2-1 line has been observed, and in most cases mapped in 10 star-forming molecular clouds (W3, NGC 1333, NGC 2071, Mon R2, CRL 961, Rho Ophi, W49N, W51A, DR 21, and Cep A). The CO J = 3-2 line has been observed in W3 and DR 21. The CO lines from all these sources are strongly self-absorbed. By comparing the present results with published CO(1-0) line profiles, it is found that large corrections to the temperatures of the cloud cores, as measured by the CO(1-0) lines, are required. The corrections for self-absorption bring the CO brightness temperatures into closer agreement with the grain temperatures inferred from far-IR photometry. B.J.

A81-35206 * Transfer of line radiation in differentially expanding atmospheres. VI - The plane parallel atmosphere with expanding and contracting regions. P. D. Noerdlinger (NASA, Ames Research Center, Moffett Field, Calif.; Michigan State University, East Lansing, Mich.). *Astrophysical Journal, Part 1*, vol. 245, Apr. 15, 1981, p. 682-703. 18 refs. NSF Grant No. AST-76-05766.

The non-LTE radiative transfer problem for a two level atom with complete redistribution over a Doppler profile is solved for a plane parallel slab (overlying a radiating photosphere) that has a velocity field which rises symmetrically from zero at either face to a central maximum. Since the velocity gradient reverses, distant layers of the slab become coupled by radiation that jumps intervening layers. The Feautrier method is used, but an iterative variant is also employed as a check in cases where poorly conditioned matrices are encountered. Approximations are developed to explain some of the principal features. It is found that the source function S tends to have two plateaus with values near 2/3 I sub 0 and 1/3 I sub 0, where I sub 0 is the photospheric continuum incident from below; the larger value lies nearer the photosphere. The upper layers sometimes exhibit a rise in S owing to interconnection by radiation to the base. It is noted that the radiation force is largest at the two faces and the midplane. Some line profiles are found to have unusually steep absorptions at rest frequency because of the low excitation in the uppermost, stationary layers. C.R.

A81-35276 * # Studies in astronomical time series analysis. I - Modeling random processes in the time domain. J. D. Scargle (NASA, Ames Research Center, Theoretical and Planetary Studies Branch, Moffett Field, Calif.). *Astrophysical Journal Supplement Series*, vol. 45, Jan. 1981, p. 1-71. 135 refs.

Several random process models in the time domain are defined and discussed. Attention is given to the moving average model, the autoregressive model, and relationships between and combinations of these models. Consideration is then given to methods for investigating pulse structure, procedures of model construction, computational methods, and numerical experiments. A FORTRAN algorithm of time series analysis has been developed which is relatively stable numerically. Results of test cases are given to study the effect of adding noise and of different distributions for the pulse amplitudes. A preliminary analysis of the light curve of the quasar 3C 272 is considered as an example. B.J.

A81-35805 * Observations of large scale steady magnetic fields in the nightside Venus ionosphere and near wake. J. G. Luhmann, R. C. Elphic, C. T. Russell, J. A. Slavin (California, University, Los Angeles, Calif.), and J. D. Mihalov (NASA, Ames Research Center, Moffett Field, Calif.). *Geophysical Research Letters*, vol. 8, May 1981, p. 517-520. 17 refs. Contract No. NAS2-9491.

Based on an analysis of a large sample of Pioneer Venus Orbiter magnetometer data, characteristics of the magnetic fields near nightside periaapsis are discussed. The observations generally indicate a weak average field of less than 10 gammas between 200 km and the periaapsis altitude of 150 km except when (1) the local solar wind dynamic pressure is high or (2) the spacecraft is in a 70 deg wide solar zenith angle range, which includes the midnight meridian and is centered west of it at 1 hr local time. The presence of radial field of alternating sign at low altitudes and in the nightside ionosphere suggests that the antiparallel magnetotail fields can terminate very close to the planet surface. B.J.

A81-37862 * Spectropolarimetry and the physical structure of proto-planetary nebulae. G. D. Schmidt (Lick Observatory, Santa Cruz, CA; Minnesota, University, Minneapolis, MN) and M. Cohen (NASA, Ames Research Center, Moffett Field, Calif.). *Astrophysical Journal*, vol. 245, Apr. 15, 1981, p. 682-703. 18 refs. NSF Grant No. AST-76-05766.

Journal, Part 1, vol. 246, June 1, 1981, p. 444-454. 40 refs. Research supported by the University of Minnesota; NSF Grant No. AST-78-19753.

Optical spectropolarimetry and spectrophotometry are presented of the two bipolar nebulae GL 618 and M2-9. A comparison of the polarization in the emission lines and the continuum is used to construct geometrical and physical models for each object. It is found that the forbidden lines arise largely in the visible nebulae, whereas the permitted lines are formed in a central high-density region and are scattered with the stellar continuum by dust grains in the lobes. Condensations are found to be an important component of the lobes, reinforcing the view that these bipolars represent a very early phase in the life of a planetary nebula. (Author)

A81-37913 * **The astronomical theory of climatic change on Mars.** O. B. Toon, J. B. Pollack (NASA, Ames Research Center, Theoretical and Planetary Studies Branch, Moffett Field, CA), W. Ward (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), J. A. Burns (Cornell University, Ithaca, NY), and K. Bilski (Informatics, Inc., Palo Alto, CA). *Icarus*, vol. 44, Dec. 1980, p. 552-607. 87 refs. Grant No. NCA2-OR-175-702.

The response of Martian climate to changes in solar energy deposition caused by variations of the Martian orbit and obliquity is examined. A systematic study is presented of the seasonal cycles of carbon dioxide, water, and dust to provide a complete picture of the climate for various orbital configurations. A new theory for the formation of the polar laminae is developed on the basis of this systematic examination. For the present orbital configuration and climate of Mars, it is shown that regolith damping of the seasonal CO₂ cycle is unlikely; the mean atmospheric pressure is probably in equilibrium with the regolith; the low albedo of the north H₂O polar cap can be explained by an admixture of 85% ice and 15% dust; and the albedo of the polar caps and the polar heat budget are very sensitive to small variations in dust deposition. B.J.

A81-37920 * **Saturn's rings - Particle composition and size distribution as constrained by observations at microwave wavelengths. II - Radio interferometric observations.** J. N. Cuzzi, J. B. Pollack, and A. L. Summers (NASA, Ames Research Center, Space Sciences Div., Moffett Field, CA). *Icarus*, vol. 44, Dec. 1980, p. 683-705. 41 refs.

Theoretical models are presented of the brightness of Saturn's rings at microwave wavelengths (0.34-21.0 cm) including both intrinsic ring emission and diffuse scattering by the rings of the planetary emission. In addition, several previously existing sets of interferometric observations of the Saturn system at 0.83, 3.71, 6.0, 11.1, and 21.0 cm wavelengths are analyzed. A comparison of models and experimental data make it possible to establish improved constraints on the properties of the rings. In particular, it is found that (1) the maximum optical depths in the rings is 1.5 ± 0.3 referred to visible wavelengths; (2) a significant decrease in ring optical depths from 3.7 to 21.0 cm makes it possible to rule out the possibility that more than 30% of the cross section of the rings is composed of particles larger than about a meter; and (3) the ring particles cannot be primarily of silicate composition (independently of particle size), and the particles cannot be primarily smaller than about 0.1 cm, independently of composition. B.J.

A81-37926 * **A proposed search on the solar neighborhood for substellar objects.** R. T. Reynolds, R. G. Walker (NASA, Ames Research Center, Moffett Field, CA), and J. C. Tarter (California, University, Berkeley, CA). *Icarus*, vol. 44, Dec. 1980, p. 772-779. 20 refs. Grant No. NCC2-36.

The Infrared Astronomical Satellite (IRAS) program will produce an extremely sensitive all-sky survey over the wavelength region 8 to 120 microns when the mission is flown in 1982. These data will provide a novel opportunity to detect planetary-sized objects having

masses smaller than 0.08 solar masses in or near the solar system. The improved detection limit of the IRAS will greatly increase the volume of space searched for such objects, as compared with previous optical and infrared studies. (Author)

A81-37973 * **Observations of Saturn in the 5- to 8-micron spectral region.** F. C. Witteborn, J. B. Pollack, J. D. Bregman, J. H. Goebel (NASA, Ames Research Center, Moffett Field, CA), B. T. Soifer (California Institute of Technology, Pasadena, CA), R. C. Puetter, R. J. Rudy, and S. P. Willner (California, University, La Jolla, CA). *Icarus*, vol. 45, Mar. 1981, p. 653-660. 32 refs. NSF-NASA-supported research.

A spectrum of Saturn obtained from the Kuiper Airborne Observatory exhibits an emission peak at 6.8 microns attributed to ethane, but is otherwise dominated by absorption from 5.3 to 7.2 microns. While the large absorption in this spectral region is consistent with the presence of ammonia gas or ammonia ice, or both, such an explanation is inconsistent with the lack of a major absorption near 3.0 microns. (Author)

A81-38494 * **Particles above the tropopause - Measurements and models of stratospheric aerosols, meteoric debris, nacreous clouds, and noctilucent clouds.** O. B. Toon and N. H. Farlow (NASA, Ames Research Center, Space Sciences Div., Moffett Field, CA). In: Annual review of earth and planetary sciences. Volume 9. (A81-38493 17-46) Palo Alto, CA, Annual Reviews, Inc., 1981, p. 19-58. 93 refs.

An outline is presented of the present status of knowledge of stratospheric aerosols, meteoric debris, nacreous clouds, and noctilucent clouds. Considerable progress has been made in studies of these particles during the previous decade and it is appropriate to synthesize the information to provide a background for studies planned for the 1980s. Numerical models of the formation, growth, and evolution are considered and a description is given of the physical processes involved, taking into account aspects of nucleation, coagulation, condensational growth, sedimentation, and questions of dynamical transport. A schematic outline of the physical and chemical processes included in a model of stratospheric aerosols is provided. G.R.

A81-38497 * **Nucleation and growth of stratospheric aerosols.** A. W. Castleman, Jr. (Colorado, University; Cooperative Institute for Research in Environmental Science, Boulder, CO) and R. G. Keesee (NASA, Ames Research Center, Moffett Field, CA). In: Annual review of earth and planetary sciences. Volume 9. (A81-38493 17-46) Palo Alto, CA, Annual Reviews, Inc., 1981, p. 227-249. 92 refs. NSF Grant No. ATM-79-13801; Contract No. DE-AC02-78EV-04776; Grants No. NSG-2248; No. DAAG29-79-C-0133.

Formation mechanisms and nucleation processes are examined, and nucleation in the stratosphere is considered, taking into account binary nucleation, ternary nucleation, binary heterogeneous nucleation, and heteromolecular nucleation. Attention is also given to the growth of aerosol particles, nucleation and growth in models, and the role of aerosols in the upper atmosphere. It is pointed out that various sampling studies and numerical models have provided evidence that the in situ oxidation of sulfur-bearing gases is responsible for the sulfate mass of the stratospheric aerosol. Data obtained by Castleman et al. (1974) suggest that there is a common source of sulfur compounds for the stratosphere of both the northern and southern hemispheres. G.R.

A81-38791 * **Long wavelength carbonyl sulfide photodissociation.** R. P. Turco (R & D Associates, Marina del Rey, CA), R. J.

Cicerone (National Center for Atmospheric Research, Boulder, CO), E. C. Y. Inn (NASA, Ames Research Center, Moffett Field, CA), and L. A. Capone (San Jose State University, San Jose, CA). *Journal of Geophysical Research*, vol. 86, June 20, 1981, p. 5373-5377. 41 refs. Contract No. NAS2-9881; Grant No. NAG1-77.

The aeronomic implications of a preliminary observation of weak OCS photoabsorption above 270 nm are investigated. It is argued that the measured cross section is consistent with a forbidden transition in this wavelength region. Model calculations are made for the OCS photodissociation rates in daylight, the OCS and SO₂ distributions in the upper atmosphere, and the budgets of sulfur in the stratosphere and OCS in the troposphere, assuming various extrapolations of the measured OCS absorption cross sections and quantum yields to longer wavelengths. It is shown that weak OCS absorption above 300 nm can have important consequences for all of these quantities. Laboratory and field experiments are identified which might lead to a better understanding of the atmospheric OCS cycle. (Author)

A81-39180 * **Studies of bipolar nebulae. VII - The exciting star of OH 0739-14 equals OH 231.8 plus 4.2/.** M. Cohen (NASA, Ames Research Center, Moffett Field, CA). *Astronomical Society of the Pacific, Publications*, vol. 93, June-July 1981, p. 288-290. 20 refs. NSF Grant No. GP-29684.

A spectral classification for the exciting star of the bipolar reflection nebula OH 0739-14, which has also been observed to be an OH/H₂O maser source, is obtained from the spectrum of the nebulosity in the range 6000-9000 Å. Spectrophotometry of the visible nebula was obtained with the Cassegrain image-tube scanner on the Lick Observatory 3-m telescope at a resolution of approximately 7 Å. The red spectrum is found to be distinguished by TiO absorption at the bandheads at 8206, 8303, 8432, 8442 and 8452 Å and VO in the 7400 and 7900 Å regions. On the basis of the depths of these bandheads and the K I 7699 Å and Ca II infrared triplet, OH 0739-14 is determined to be of spectral type M9 III. The underlying star thus represents the coolest known star to occur in a bipolar system. A.L.W.

A81-39799 * **Numerical three dimensional calculations of tidally induced binary protostar formation.** A. P. Boss (NASA, Ames Research Center, Space Science Div., Moffett Field, CA). *Astrophysical Journal, Part 1*, vol. 246, June 15, 1981, p. 866-878. 28 refs.

The manner in which interstellar clouds fragment into sub-condensations capable of becoming stars is still unknown. A variety of mechanisms may be responsible for cloud fragmentation. The considered investigation is concerned with a mechanism which is based on tidal forces due to a companion cloud. A 3D code is used to study the tidal effects of point sources of various masses located in the equatorial plane of an initially uniform density, uniformly rotating, isothermal gas cloud. It is found that tidal forces can be quite effective at inducing fragmentation in an initially uniform cloud, although the effects are most pronounced for low thermal energy clouds, perturbed by perhaps unreasonably large tidal forces. It is also seen that tidal forces may be much less efficient at preventing the collapse of a cloud than has previously been supposed. G.R.

A81-39831 * **Radially propagating shock waves in the outer heliosphere - The evidence from Pioneer 10 energetic particle and plasma observations.** F. B. McDonald, J. H. Trainor (NASA, Goddard Space Flight Center, Laboratory for High Energy Astrophysics, Greenbelt, MD), J. D. Mihalov, J. H. Wolfe (NASA, Ames Research Center, Space Science Div., Moffett Field, CA), and W. R. Webber (New Hampshire University, Durham, NH). *Astrophysical Journal, Part 2 - Letters to the Editor*, vol. 246, June 15, 1981, p. L165-L169. 27 refs.

At heliocentric distances between 14 and 22 AU, some 14 increases in the flux of 1 MeV protons have been identified over a 3 yr period by the NASA Goddard/University of New Hampshire cosmic-ray experiment on Pioneer 10. These increases appear to be associated with large solar flares. Combining the particle data with the Pioneer 10 plasma observations from the NASA/Ames plasma analyzer reveals that the particle increases are produced by radially propagating shock waves generated by the solar events. While the characteristics of these particle events in the distant heliosphere appear to differ greatly from those observed at 1 AU, they represent the evolution expected as the interplanetary magnetic field becomes almost azimuthal. These long-lived shocks provide a valuable in situ laboratory for directly studying particle acceleration under a variety of conditions. They may also represent a significant factor in producing the long-term modulation of galactic cosmic rays. (Author)

A81-39882 * **Atmospheres of the terrestrial planets.** J. B. Pollack (NASA, Ames Research Center, Space Science Div., Moffett Field, CA). In: *The new solar system*. (A81-39876 18-91) Cambridge, Cambridge University Press; Cambridge, MA, Sky Publishing Corp., 1981, p. 57-70, 215. 5 refs.

The paper reviews current knowledge of the characteristics of atmospheres surrounding the terrestrial planets; attention is given to composition, temperature, characteristics of the upper atmospheres, and meteorology. In addition, the long-term history of the atmospheres is discussed, along with some of the major climatic changes that have occurred. Finally, consideration is given to future efforts that will enhance the understanding of these subjects. B.J.

A81-39891 * **Titan.** J. B. Pollack (NASA, Ames Research Center, Space Science Div., Moffett Field, CA). In: *The new solar system*. (A81-39876 18-91) Cambridge, Cambridge University Press; Cambridge, MA, Sky Publishing Corp., 1981, p. 161-166, 217.

The paper reviews current knowledge about Titan's atmosphere, surface, interior, and nearby environment. An attempt is made to place the satellite's history within the context of the formation of the Saturn system and to describe possible evolutionary paths for its atmosphere and interior. B.J.

A81-40819 * **The Martian twilight.** R. Kahn, R. Goody (Harvard University, Cambridge, MA), and J. Pollack (NASA, Ames Research Center, Space Science Div., Moffett Field, CA). *Journal of Geophysical Research*, vol. 86, July 1, 1981, p. 5833-5838. 10 refs. Grants No. NSG-7398; No. NGL-22-007-228.

The changing sky brightness during the Martian twilight as measured by the Viking lander cameras is shown to be consistent with data obtained from sky brightness measurements. An exponential distribution of dust with a scale height of 10 km, equal to the atmospheric scale height, is consistent with the shape of the light curve. Multiple scattering resulting from the forward scattering peak of large particles makes a major contribution to the intensity of the twilight. The spectral distribution of light in the twilight sky may require slightly different optical properties for the scattering particles at high levels from those of the aerosol at lower levels. (Author)

A81-41185 * **On the structure and composition of Uranus and Neptune.** M. Podolak (NASA, Ames Research Center, Theoretical and Planetary Sciences Branch, Moffett Field, CA; Tel Aviv University, Tel Aviv, Israel) and R. T. Reynolds (NASA, Ames Research Center, Theoretical and Planetary Science Branch, Moffett Field, CA). *Icarus*, vol. 46, Apr. 1981, p. 40-50. 33 refs. Grant No. NCA2-OR-340-002.

A series of models is presented of Uranus and Neptune in which the relative amounts of (1) rock, (2) ices, and (3) hydrogen and helium are allowed to vary. By fitting the density and the gravitational quadrupole moment, the model composition can be determined. Because of the ambiguity in the rotation periods of these planets, several possible models are presented and discussed.

(Author)

A81-44048 * Investigation of the 2-0 pressure-induced vibrational absorption spectrum of hydrogen at temperatures below ambient. P. M. Silvaggio, D. Goorvitch, and R. W. Boese (NASA, Ames Research Center, Moffett Field, CA). *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 26, Aug. 1981, p. 103-106. 10 refs.

A theoretical fit has been made to our laboratory measurements of the 2-0 collisionally induced H₂ absorption band for temperatures of 122 and 273.3 K and at a density of 20 amagats. A Lennard-Jones 6-12 intermolecular potential and a Birnbaum-Cohen line profile have been used. The fit resulted in a chi-square of 0.2%. Line widths have also been derived as a function of temperature. The lifetimes of the states have been calculated.

(Author)

A81-44162 * Implications of smaller concentrations of stratospheric OH - A two-dimensional model study of ozone perturbations. R. C. Whitten, W. J. Borucki, H. T. Woodward (NASA, Ames Research Center, Space Science Div., Moffett Field, CA), L. A. Capone, C. A. Riegel (San Jose State University, San Jose, CA), R. P. Turco (R & D Associates, Marina del Rey, CA), I. G. Poppoff (Flick Point Associates, Carmel Bay, CA), and K. Santhanam (Informatics, Inc., Palo Alto, CA). *Atmospheric Environment*, vol. 15, no. 9, 1981, p. 1583-1589. 42 refs.

There is growing observational evidence that stratospheric OH concentrations are smaller than models have been predicting. Using very recent HO_x reaction rate coefficient measurements in a two-dimensional photochemical model, results which support these observations are obtained. As a consequence of smaller OH concentrations, we show that perturbations of stratospheric ozone by NO_x (SST emissions and nitrogen fertilizers) may be larger than expected, while perturbations due to added water vapor and chlorine (SSTs and chlorofluoromethanes, respectively) may be smaller.

(Author)

A81-44515 * # Measurements of CF₂Cl₂, CFCI₃, and N₂O in the lower stratosphere between 2 deg S and 73 deg N latitude. J. F. Vedder, E. C. Y. Inn, B. J. Tyson, C. A. Boitnott (NASA, Ames Research Center, Atmospheric Experiments Branch, Moffett Field, CA), and D. O'Hara (EAL Corp., Richmond, CA). *Journal of Geophysical Research*, vol. 86, Aug. 20, 1981, p. 7363-7368. 20 refs.

Mixing ratios are presented for CF₂Cl₂, CFCI₃, and N₂O in the lower stratosphere. They are derived from measurements made on samples collected by a high-altitude aircraft during a survey in the northern hemisphere in the summer of 1977. The vertical distributions of the mixing ratios of these species show a decrease with increasing altitude and a marked decrease at a given altitude with increasing latitude from 2 deg S to 73 deg N latitude. These results agree with measurements at similar latitudes in the fall of 1976 and with results of other experiments. The experimental apparatus and procedures are described in greater detail than in previous papers.

(Author)

A81-45209 * Implications of Titan's north-south brightness asymmetry. L. A. Sromovsky, V. E. Suomi, R. J. Krauss, S. S. Limaye, H. E. Revercomb (Wisconsin, University, Madison, WI), J. B. Pollack (NASA, Ames Research Center, Moffett Field, CA), T. Owen (New York, State University, Stony Brook, NY), and C. Sagan

(Cornell University, Ithaca, NY). *Nature*, vol. 292, Aug. 20, 1981, p. 698-702. 11 refs. Contract No. JPL-953615.

Voyager 1 images of Titan, when normalized to remove limb darkening, reveal an axially symmetric brightness pattern with significant north-south asymmetry. This interhemispheric contrast seems to be a response to seasonal solar heating variations resulting from Titan's inclined spin axis. The contrast significantly lags the solar forcing, indicating that its production involves the atmosphere well below the unit optical depth level. The contrast has a significant effect on Titan's disk-integrated brightness as seen from earth, and probably accounts for most of the observed long term variation, with solar UV variations accounting for the remainder.

(Author)

A81-45210 * Density waves in Saturn's rings. J. N. Cuzzi (NASA, Ames Research Center, Moffett Field, CA), J. J. Lissauer, and F. H. Shu (California, University, Berkeley, CA). *Nature*, vol. 292, Aug. 20, 1981, p. 703-707. 18 refs. Grant No. NCA2-OR-050-102.

Certain radial brightness variations in the outer Cassini division of Saturn's rings may be spiral density waves driven by Saturn's large moon Iapetus, in which case a value of approximately 16 g/sq cm for the surface density is calculated in the region where the waves are seen. The kinematic viscosity in the same region is approximately 170 sq cm/s and the vertical scale height of the ring is estimated to be a maximum of approximately 40 m.

(Author)

A81-45211 * Moonlets in Saturn's rings. J. J. Lissauer, F. H. Shu (California, University, Berkeley, CA), and J. N. Cuzzi (NASA, Ames Research Center, Moffett Field, CA). *Nature*, vol. 292, Aug. 20, 1981, p. 707-711. 20 refs. Grant No. NCA2-OR-050-102.

The brightness structure within Cassini's division in Saturn's rings is explained in terms of perturbations produced by moonlets embedded within an optically thin disk of smaller ring particles. The moonlets exert gravitational torques on neighboring ring particles and create gaps; diffusion acts to fill the gaps. A new explanation is offered for the inner edge of the Cassini division being located at the 2:1 resonance with Mimas.

(Author)

A81-46140 * The infrared emission from supernova condensates. E. Dwek (Maryland, University, College Park, MD) and M. W. Werner (NASA, Ames Research Center, Space Sciences Div., Moffett Field, CA). *Astrophysical Journal, Part 1*, vol. 248, Aug. 15, 1981, p. 138-151. 45 refs.

The possibility of detecting grains formed in supernovae by observations of their emission in the infrared is examined. The basic processes determining the temperature and infrared radiation of grains in supernova environments are analyzed, and the results are used to estimate the infrared emission from the highly metal enriched fast moving knots in Cas A. The predicted fluxes lie within the reach of current ground-based facilities at 10 microns, and their emission should be detectable throughout the infrared band with cryogenic space telescopes.

(Author)

A81-46876 * # An objective method for determining the generalized transport tensor for two-dimensional Eulerian models. E. F. Danielsen (NASA, Ames Research Center, Moffett Field, CA). *Journal of the Atmospheric Sciences*, vol. 38, July 1981, p. 1319-1339. 30 refs. FAA-sponsored research.

An objective method for deriving the components of a generalized transport tensor for a two-dimensional model is presented. Representative meridional and vertical velocities and thermodynamic scalars at a uniform grid are used to reduce the problem to the solution of two flux equations for two unknowns. One unknown is the stream-function, coefficient of an antisymmetric tensor, which

corrects the Eulerian mean motions for Stokes drift; the other is a time constant, which converts the deviatory velocity tensor to a symmetric transport tensor. The complete asymmetric tensor, called a transport tensor, has a divergence which yields both advection and diffusion by the deviatory velocities. Advantages and disadvantages of Lagrangian and Eulerian averages are discussed, and meridional-vertical velocity correlations are provided. J.F.

A81-47274 * **Formation of organic molecules on Titan.** L. A. Capone (San Jose State University, San Jose, CA), S. S. Prasad, W. T. Huntress (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), R. C. Whitten (NASA, Ames Research Center, Space Science Div., Moffett Field, CA), J. Dubach (Massachusetts University, Amherst, MA), and K. Santhanam (Informatics, Inc., Palo Alto, CA). *Nature*, vol. 293, Sept. 3, 1981, p. 45, 46. 17 refs.

A mechanism is proposed for the formation of complex organic nitrogen compounds in the dense lower atmosphere of Titan. The mechanism is based on three-body association reactions with HCNH^+ ions formed by the reaction of N^+ with CH_4 , which lead to the production of ethyl cyanide, vinyl cyanide and cyanoacetylene. Calculations for a model atmosphere consistent with the preliminary interpretation of Voyager 1 data for the region of maximum cosmic ray activated chemistry, corresponding to a temperature between 150 and 160 K and a pressure of 20 mbar, are presented which show substantial organic nitrile and hydrogen cyanide production rates. Based on these production rates, it is expected that significant equilibrium concentrations of these compounds will be found on Titan. A.L.W.

A81-48034 * **Are we beginning to understand T Tauri stars.** M. Cohen (NASA, Ames Research Center, Moffett Field, CA). *Sky and Telescope*, vol. 62, Oct. 1981, p. 300-303.

An international meeting of astronomers in April 1981 in Portugal to discuss recent data on T Tauri stars is described. It is pointed out that T Tauri stars all vary irregularly in brightness, occur in intimate association with dusty molecular clouds, and exhibit bright optical emission lines, principally of hydrogen, helium, and iron. Stars with masses roughly 0.2 to three times the sun's and with ages from 100,000 to 1,000,000 years are typical of the T Tauri regime. It is thought that the often rich emission-line spectra seen at visible wavelengths indicate the presence of a stellar chromosphere, where the temperature rises steeply from the usual cool photospheric values around 4,000 to 5,000 K. Even though a recent extensive survey of T Tauri stars has been completed, no clear role for rotation in producing radio emission or stellar winds has yet emerged. C.R.

A81-48223 * **Tunguska meteor fall of 1908 - Effects on stratospheric ozone.** R. P. Turco (R & D Associates, Marina del Rey, CA), O. B. Toon, C. Park, R. C. Whitten, J. B. Pollack (NASA Ames Research Center, Moffett Field, CA), and P. Noerdlinger (Michigan State University, East Lansing, MI). *Science*, vol. 214, Oct. 2, 1981, p. 19-23. 47 refs. Contract No. NAS2-9881.

The Tunguska meteor, whose disintegration over Siberia in 1908 may have generated as much as 30 million metric tons of nitric oxide (NO) in the stratosphere and mesosphere, is discussed. The photochemical aftereffects of the event are simulated using a comprehensive model of atmospheric trace composition. Calculations are made which indicate that up to 45% of the ozone in the Northern Hemisphere may have been depleted by the meteor's nitric oxide cloud early in 1909 and that large ozone reductions may have persisted until 1912. Measurements of atmospheric transparency by the Smithsonian Astrophysical Observatory for the years 1909-1911 (Moskovskii Institut Radiotekhniki, Elektroniki i Avtomatiki, Moscow, USSR). (*Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 16, Apr. 1980, p. 382-388.) *Academy of Sciences*,

USSR, Izvestiia, Atmospheric and Oceanic Physics, vol. 16, Nov. 1980, p. 256-260. 9 refs. Translation.
(For abstract see issue 13, p. 2409, Accession no. A80-34132)

A81-48735 * **Spectropolarimetry of Herbig-Haro objects and the exciting star of HH 30.** M. Cohen (NASA, Ames Research Center, Moffett Field, CA) and G. D. Schmidt (Minnesota University, Minneapolis, MN). *Astronomical Journal*, vol. 86, Aug. 1981, p. 1228-1231. 17 refs. Research supported by the University of Minnesota; NSF Grant No. AST-78-19753.

Spectrophotometric and spectropolarimetric observations are presented of three HH objects: HH 11, 30, and 43. Although null polarization results are obtained for HH 11 and 43, the unusually strong continuum of HH 30 is linearly polarized by 3%. The emission lines in this nebula are unpolarized. The electric vector position angle appropriate to the continuum polarization, and the presence of Fe II emission lines apparently from the photosphere of a T Tauri-like star, indicate HL Tau as the exciting/illuminating star for HH 30. Evidence is adduced for a highly anisotropic distribution of circumstellar obscuration around this star. (Author)

A81-49037 * **The abundance of argon at the galactic center.** D. F. Lester, J. D. Bregman, F. C. Witteborn (NASA, Ames Research Center, Moffett Field, CA), D. M. Rank, and H. L. Dinerstein (Lick Observatory, Santa Cruz, CA). *Astrophysical Journal, Part 1*, vol. 248, Sept. 1, 1981, p. 524-527. 31 refs.

Measurements of forbidden line Ar II 6.99 micron and Pf alpha 7.45 micron made from the Kuiper Airborne Observatory are presented for Sgr A, the H II region at the center of the Galaxy. These line strengths, when combined with ground-based measurements, suggest a factor of enhancement of two in the Ar/H ratio in the galactic center region relative to that in the sun and in the solar neighborhood. The accuracy of the determination is presently limited by the uncertainty in the collision strength for Ar(+). (Author)

A81-49679 * # **Interplanetary Alfvénic fluctuations - A stochastic model.** A. Barnes (NASA, Ames Research Center, Theoretical and Planetary Studies Branch, Moffett Field, CA). *Journal of Geophysical Research*, vol. 86, Sept. 1, 1981, p. 7498-7506. 24 refs.

The concept of minimum variance is investigated for nonplanar interplanetary Alfvénic fluctuations in which the field direction varies randomly. The theory of the random wandering of a vector of constant length is developed as a representation of the magnetic field, and it is found that the minimum variance tends to coincide with the mean field directions over the correlation time of the fluctuations. The Fokker-Planck limit of the theory is then developed and used to analyze the statistic distribution of field directions with and without a reflecting barrier. Results suggest that the tendency of the Alfvénic fluctuations to have a direction of minimum variance statistically aligned with the mean magnetic field may be purely a consequence of the randomness of the fluctuation and not imply that the fluctuations are necessarily plane waves. Extensive statistical studies of the observed directional variations of the interplanetary magnetic field are necessary to test this hypothesis. A.L.W.

CONFERENCE AND MEETING PAPERS

A81-12466 * # **Large-scale modulation of galactic cosmic rays and anomalous He observed at not less than 16 AU with Pioneer 10.** K. R. Pyle, J. A. Simpson (Chicago University, Chicago, Ill.), J. D. Mihalov, and J. H. Wolfe (NASA, Ames Research Center, Moffett

Field, Calif.). In: International Cosmic Ray Conference, 16th, Kyoto, Japan, August 6-18, 1979, Conference Papers. Volume 5. (A81-12386 02-93) Tokyo, University of Tokyo, 1980, p. 345-350. 6 refs. NSF Grant No. ATM-77-24494; Contract No. NAS2-6551.

High-speed solar wind streams issued from specific ranges of solar longitude or evolved into a single stream at not less than 16 AU during 1978. Shock waves associated with these streams cause a large decrease in cosmic ray intensity starting at 1 AU in April and appears progressively with time outward to 16 AU; a stepwise intensity decrease then occurs for both the galactic cosmic rays and the anomalous He component. The flare-accelerated nuclei show a new aspect of solar wave propagation in the outer solar system; at about 16 to 18 AU, the intensity builds up because of dispersion, reaches a flux level, and finally declines when the outward rate of escape becomes dominant. A.T.

A81-20741 * # Aircraft NO_x/ emissions and stratospheric ozone reductions - Another look. R. P. Turco (R & D Associates, Marina del Rey, Calif.), R. C. Whitten, O. B. Toon, E. C. Y. Inn (NASA, Ames Research Center, Moffett Field, Calif.), and P. Hamill (Systems and Applied Sciences Corp., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0306.* 7 p. 33 refs. Contract No. NAS2-9881.

New estimates for stratospheric ozone perturbations attributable to supersonic transport (SST) emissions are presented. First, a review is given of recent data pointing to lower OH concentrations below 30 km, as compared to the values predicted by photochemical models. The evidence for lower OH comes from a wide range of laboratory and atmospheric studies. The sensitivity of theoretical estimates of ozone change to OH abundances, and the coupling mechanisms between the O(x)-NO(x)-HO(x)-Cl(x) families which are responsible for the sensitivity, are discussed. Updated calculations for SST-induced ozone alterations are compared with older predictions. For example, assuming continuous aircraft injection of NO₂ at 20 km at a rate of 1 x 10 to the 9th kg per year (globally), a 4% ozone decrease, is now calculated where earlier a 3% ozone increase was found. This large variance from previous forecasts suggests that new assessments of certain other polluting agents, particularly nitrogen fertilizers, are needed. (Author)

A81-25637 * A comparison of alternative methods for detecting other planetary systems. D. C. Black (NASA, Ames Research Center, Space Science Div., Moffett Field, Calif.). In: Strategies for the search for life in the universe; Proceedings of the Meeting, Montreal, Canada, August 15, 16, 1979. (A81-25626 10-88) Dordrecht, D. Reidel Publishing Co., 1980, p. 167-175. 5 refs.

Independent methods considered for use in the direct or indirect detection of extrasolar planetary systems are compared. Consideration is given to the principles, advantages and disadvantages of indirect astrometric, spectroscopic and photometric methods, and the direct detection of the intrinsic thermal radiation, reflected central star radiation or intrinsic nonthermal radiation of a planet. The importance of a redundancy of detection methods as well as instrumentation within a given method is pointed out. A.L.W.

A81-27730 * Theoretical considerations of shock wave behavior. D. Hollenbach (NASA, Ames Research Center, Moffett Field, Calif.). In: Interstellar molecules; Proceedings of the Symposium, Mont Tremblant, Quebec, Canada, August 6-10, 1979. (A81-27676 11-90) Dordrecht, D. Reidel Publishing Co., 1980, p. 445-452; Discussion, p. 452, 453. 30 refs. NSF Grant No. AST-77-23069.

Interstellar shock waves have a significant influence on the structure and dynamics of interstellar matter and probably trigger star formation in suitably dense regions. The overall structure of

regions near shock waves is reviewed; in addition, the main observational effects of shocks on interstellar molecules are discussed including: (1) acceleration to velocities in the 1 km/s to 100 km/s range relative to the ambient gas, (2) excitation of infrared lines in the heated postshock gas, and (3) production of high abundances of certain molecular species such as H, OH, H₂O, CH(+), OCS, and SiO through high temperature chemical reactions in the postshock gas at temperatures above 1000 K. The molecular region around the BN infrared source in Orion and the high velocity molecules in IC443 are discussed as possible examples of shocked molecular gas. (Author)

A81-36895 * Far-infrared /FIR/ optical black bidirectional reflectance distribution function /BRDF/. S. M. Smith (NASA, Ames Research Center, Moffett Field, Calif.). In: Radiation scattering in optical systems; Proceedings of the Seminar, Huntsville, Ala., September 30-October 1, 1980. (A81-36878 16-74) Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1981, p. 161-168. 6 refs.

A nonspecular reflectometer and its operation at far-infrared wavelengths are described. Large differences in nonspecular reflectance were found to exist between different optically black coatings. Normal incidence bidirectional reflectance distribution function (BRDF) measurements at wavelengths between 12 and 316 microns of three black coatings show that their mean BRDFs increase with wavelength. The specularly of two of these coatings also showed a strong wavelength dependence, while the specularly of one coating seemed independent of wavelength. The BRDF of one coating depended on the angle of incidence at 12 and 38 microns, but not at 316 microns. Beyond 200 microns, it was found necessary to correct the measurements for the beam spread of the instrument. (Author)

A81-37211 * Orbital operations with the Shuttle Infrared Telescope Facility /SIRTF/. M. W. Werner and K. R. Lorell (NASA, Ames Research Center, Moffett Field, Calif.). In: Shuttle pointing of electro-optical experiments; Proceedings of the Seminar, Los Angeles, Calif., February 10-13, 1981. (A81-37177 16-19) Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1981, p. 344-354. 12 refs.

The Shuttle Infrared Telescope Facility (SIRTF) is a cryogenically-cooled, 1-m-class telescope that will be operated from the Space Shuttle as an observatory for infrared astronomy. This paper discusses the scientific constraints on and the requirements for pointing and controlling SIRTF as well as several aspects of SIRTF orbital operations. The basic pointing requirement is for an rms stability of 0.25 arcsec, which is necessary to realize the full angular resolution of the 5-micron diffraction-limited SIRTF. Achieving this stability requires the use of hardware and software integral to SIRTF working interactively with the gyro-stabilized Shuttle pointing-mount. The higher sensitivity of SIRTF, together with orbital and time constraints, puts a premium on rapid target acquisition and on efficient operational and observational procedures. Several possible acquisition modes are discussed, and the importance of source acquisition by maximizing the output of an infrared detector is emphasized. (Author)

A81-48836 * The influence of solar UV variations on climate. W. J. Borucki, J. B. Pollack, O. B. Toon, H. T. Woodward (NASA, Ames Research Center, Space Science Div., Moffett Field, CA), and D. R. Wiedman (NASA, Ames Research Center, Space Science Div., Moffett Field; Informatics, Inc., Palo Alto, CA). In: The ancient sun: Fossil record in the earth, moon and meteorites; Proceedings of the Conference, Boulder, CO, October 16-19, 1979. (A81-48801 24-91) New York and Oxford, Pergamon Press, 1980, p. 513-522. 18 refs.

The effects on the terrestrial ozone abundance and temperature (and hence on the earth's climate) of periodic variations in the solar spectrum are investigated. Temporal variations of the solar UV

spectrum are modeled in accordance with the measurements of Heath and Thekaekara (1977), and the spectrum at wavelengths greater than 2900 Å is altered uniformly by small amounts so that the total luminosity remains constant with time. One-dimensional photochemical-radiative-convective models are used to predict the response of the earth's surface to the solar spectral changes. Results show that the data interpreted by Heath and Thekaekara to indicate that the solar UV flux varies by a factor of 2.5 at 1750 Å from solar minimum to solar maximum are inconsistent with the historical records of ozone abundance. It is concluded, however, that if the amplitude of solar UV variations increases with increasing period, and if the spectral characteristics variations are similar to the well established solar UV variations over a solar rotation period, these variations could have a significant impact on the earth's climate and the biosphere. K.S.

A81-48837* A brief review of the evidence for solar variability on the planets. O. B. Toon, J. B. Pollack, and K. Rages (NASA, Ames Research Center, Space Science Div., Moffett Field, CA). In: The ancient sun: Fossil record in the earth, moon and meteorites; Proceedings of the Conference, Boulder, CO, October 16-19, 1979. (A81-48801 24-91) New York and Oxford, Pergamon Press, 1980, p. 523-531. 23 refs.

An outline of the most recent and complete reviews on the history of Martian climate is presented and compared to the history of terrestrial climate. Suggestions are made on how solar luminosity changes may have affected both planets. Observations of the albedo of Titan occurring over a solar cycle are discussed, and the solar mechanisms that might be responsible for the observed albedo changes are considered. K.S.

THERMO- AND GAS-DYNAMICS DIVISION

NASA FORMAL REPORTS

N81-16977* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STEADY AND NONSTEADY SUPERSONIC TURBULENT AFTERBODY FLOW

Kenneth K. Yoshikawa and Alan A. Wray Feb. 1981 23 p refs
(NASA-TP-1769; A-8271) Avail: NTIS HC A02/MF A01 CSCL 01A

The effect of the specific heat ratio gamma of the incoming ideal gas on the flow properties, especially on pressure distributions along the base and sting surfaces and on reattachment distance, was investigated. The specific heat ratios considered were gamma = 1.2, 1.4, and 1.667. Also, effects of other major parameters, such as eddy-viscosity coefficient (or effective Reynolds number) and Mach number, on the afterbody pressure and reattachment distance were studied and are discussed. Evolution of shock induced flow and stabilization time were examined and are discussed for a transient problem. The important influence of the flow-field geometry, pressure distributions, and reattachment distance on the aerodynamics radiative heat transfer for an atmosphere entry probe in high speed flight are briefly described. T.M.

N81-33856* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NUMERICAL BOUNDARY CONDITION PROCEDURES

Oct. 1981 383 p refs Symp. held at Moffett Field, Calif., 19-20 Oct. 1981
(NASA-CP-2201; A-8736) Avail: NTIS HC A17/MF A01 CSCL 12A

Topics include numerical procedures for treating inflow and outflow boundaries, steady and unsteady discontinuous surfaces, far field boundaries, and multiblock grids. In addition, the effects of numerical boundary approximations on stability, accuracy, and convergence rate of the numerical solution are discussed. For individual titles, see N81-33857 through N81-33878.

N81-33879* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MULTIGRID METHODS

Oct. 1981 304 p refs Symp. held at Moffett Field, Calif., 21-22 Oct. 1981
(NASA-CP-2202; A-8738) Avail: NTIS HC A14/MF A01 CSCL 12A

Developments in numerical solution of certain types of partial differential equations by rapidly converging sequences of

operations on supporting grids that range from very fine to very coarse are presented. For individual titles, see N81-33880 through N81-33894.

NASA TECHNICAL MEMORANDA

N81-14265* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL STUDY OF SUPERSONIC VISCOUS LEESIDE FLOW OVER A SLENDER DELTA WING

Joachim Szodrach Dec. 1980 62 p refs
(NASA-TM-81248; A-8408) Avail: NTIS HC A04/MF A01 CSCL 20D

An investigation was conducted to study in detail the vortical flow over the leeward side of a 70 deg swept delta wing having subsonic and supersonic leading edges. Two types of flow were encountered and studied, namely leading edge separation and separation with a shock. Especially for the latter type, Reynolds number plays an important role and unexpected strong streamwise vortices were observed. An optical method is described to obtain a first approximation of shear stress values in the streamwise direction across the wing span. Author

N81-16136* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STRAIN RATE, TEMPERATURE, AND HUMIDITY ON STRENGTH AND MODULI OF A GRAPHITE/EPOXY COMPOSITE

J. M. Lifshitz Jan. 1981 26 p refs
(NASA-TM-81247; A-8381) Avail: NTIS HC A03/MF A01 CSCL 11D

Results of an experimental study of the influence of strain rate, temperature and humidity on the mechanical behavior of a graphite/epoxy fiber composite are presented. Three principal strengths (longitudinal, transverse and shear) and four basic moduli (E1, E2, G12 and U12) of a unidirectional graphite/epoxy composite were followed as a function of strain rate, temperature and humidity. Each test was performed at a constant tensile strain rate in an environmental chamber providing simultaneous temperature and humidity control. Prior to testing, specimens were given a moisture preconditioning treatment at 60 C. Values for the matrix dominated moduli and strength were significantly influenced by both environmental and rate parameters, whereas the fiber dominated moduli were not. However, the longitudinal strength was significantly influenced by temperature and moisture content. A qualitative explanation for these observations is presented. Author

N81-18742*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PREDICTED AND EXPERIMENTAL STEADY AND UNSTEADY TRANSONIC FLOWS ABOUT A BICONVEX AIRFOIL
 Lionel L. Levy, Jr. Feb. 1981 20 p refs
 (NASA-TM-81262; A-8457) Avail: NTIS HC A02/MF A01 CSCL 20D

Results of computer code time dependent solutions of the two dimensional compressible Navier-Stokes equations and the results of independent experiments are compared to verify the Mach number range for instabilities in the transonic flow field about a 14 percent thick biconvex airfoil at an angle of attack of 0 deg and a Reynolds number of 7 million. The experiments were conducted in a transonic, slotted wall wind tunnel. The computer code included an algebraic eddy viscosity turbulence model developed for steady flows, and all computations were made using free flight boundary conditions. All of the features documented experimentally for both steady and unsteady flows were predicted qualitatively; even with the above simplifications, the predictions were, on the whole, in good quantitative agreement with experiment. In particular, predicted time histories of shock wave position, surface pressures, lift, and pitching moment were found to be in very good agreement with experiment for an unsteady flow. Depending upon the free stream Mach number for steady flows, the surface pressure downstream of the shock wave or the shock wave location was not well predicted. M.G.

N81-19276*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CORROSION OF 310 STAINLESS STEEL IN H2-H2O-H2S GAS MIXTURES: STUDIES AT CONSTANT TEMPERATURE AND FIXED OXYGEN POTENTIAL
 D. Bhogeswara Rao (California Univ., Lawrence Berkeley Lab.), K. T. Jacob (California Univ., Berkeley), and Howard G. Nelson Feb. 1981 40 p refs
 (NASA-TM-81242; A-8349) Avail: NTIS HC A03/MF A01 CSCL 11F

Corrosion of SAE 310 stainless steel in H2-H2O-H2S gas mixtures was studied at a constant temperature of 1150 K. Reactive gas mixtures were chosen to yield a constant oxygen potential of approximately 6×10 to the minus 13th power/cu Nm and sulfur potentials ranging from 0.19×10 to the minus 2nd power/cu Nm to 33×10 to the minus 2nd power/cu Nm. The kinetics of corrosion were determined using a thermobalance, and the scales were analyzed using metallography, scanning electron microscopy, and energy dispersive X-ray analysis. Two corrosion regimes, which were dependent on sulfur potential, were identified. At high sulfur potentials ($p_{\text{sub S sub 2}}$ less than or equal to 2.7×10 to the minus 2nd power/cu Nm) the corrosion rates were high, the kinetics obeyed a linear rate equation, and the scales consisted mainly of sulfide phases similar to those observed from pure sulfication. At low sulfur potentials ($P_{\text{sub S sub 2}}$ less than or equal to 0.19×10 to the minus 2nd power/cu Nm) the corrosion rates were low, the kinetics obeyed a parabolic rate equation, and scales consisted mainly of oxide phases. Author

N81-19834*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL APPROXIMATION OF BOUNDARY CONDITIONS WITH APPLICATIONS TO INVISCID EQUATIONS OF GAS DYNAMICS
 H. C. Yee Mar. 1981 87 p refs
 (NASA-TM-81265; A-8480) Avail: NTIS HC A05/MF A01 CSCL 20D

A comprehensive overview of the state of the art of well-posedness and stability analysis of difference approximations for initial boundary value problems of the hyperbolic type is presented. The applicability of recent theoretical development to practical calculations for nonlinear gas dynamics is examined. The one dimensional inviscid gas dynamics equations in conservation law form are selected for numerical experiments. The class of implicit schemes developed from linear multistep methods in ordinary differential equations is chosen and the use of linear extrapolation as an explicit or implicit boundary scheme is

emphasized. Specification of boundary data in the primitive variables and computation in terms of the conservative variables in the interior is discussed. Some numerical examples for the quasi-one-dimensional nozzle are given. Author

N81-21134*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PHYSICAL AGING IN GRAPHITE EPOXY COMPOSITES
 Eric S. W. Kong (Stanford Univ.) Apr. 1981 25 p refs
 (NASA-TM-81273; A-8495) Avail: NTIS HC A02/MF A01 CSCL 11D

The matrix dominated mechanical behavior of a graphite epoxy composite was found to be affected by sub Tg annealing. Postcured + or - 45 deg 4S specimens of Thorne 300 graphite/Narmco 5208 epoxy were quenched from above Tg and given a sub Tg annealing at 140 C for times up to 10 to the 5th power min. The ultimate tensile strength, strain to break, and toughness of the composite material were found to decrease as functions of sub Tg annealing time. No weight loss was observed during the sub Tg annealing. The time dependent change in mechanical behavior is explained on the basis of free volume changes that are related to the physical aging of the nonequilibrium glassy network epoxy. The results imply possible changes in composite properties with service time. Author

N81-23037*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TOPOLOGY OF THREE-DIMENSIONAL SEPARATED FLOWS
 Murray Tobak and David J. Peake Apr. 1981 46 p refs
 (NASA-TM-81294; A-8554) Avail: NTIS HC A03/MF A01 CSCL 01A

Based on the hypothesis that patterns of skin-friction lines and external streamlines reflect the properties of continuous vector fields, topology rules define a small number of singular points (nodes, saddle points, and foci) that characterize the patterns on the surface and on particular projections of the flow (e.g., the crossflow plane). The restricted number of singular points and the rules that they obey are considered as an organizing principle whose finite number of elements can be combined in various ways to connect together the properties common to all steady three dimensional viscous flows. Introduction of a distinction between local and global properties of the flow resolves an ambiguity in the proper definition of a three dimensional separated flow. Adoption of the notions of topological structure, structural stability, and bifurcation provides a framework to describe how three dimensional separated flows originate and succeed each other as the relevant parameters of the problem are varied. Author

N81-26074*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TAIR: A TRANSONIC AIRFOIL ANALYSIS COMPUTER CODE
 F. Carroll Dougherty, Terry L. Holst, Karen L. Grundy (Informatics, Inc., Palo Alto, Calif.), and Scott D. Thomas (Informatics, Inc., Palo Alto, Calif.) May 1981 91 p refs
 (NASA-TM-81296; A-8594) Avail: NTIS HC A05/MF A01 CSCL 01A

The operation of the TAIR (Transonic AIRfoil) computer code, which uses a fast, fully implicit algorithm to solve the conservative full-potential equation for transonic flow fields about arbitrary airfoils, is described on two levels of sophistication: simplified operation and detailed operation. The program organization and theory are elaborated to simplify modification of TAIR for new applications. Examples with input and output are given for a wide range of cases, including incompressible, subcritical compressible, and transonic calculations. A.R.H.

N81-28371* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

UNSTEADY NEWTON-BUSEMANN FLOW THEORY. PART 2: BODIES OF REVOLUTION

W. H. Hui and Murray Tobak (Waterloo Univ., Ontario) Apr. 1981 37 p refs Backup document for AIAA journal scheduled for publication in AIAA Journal, Oct. 1981

(NASA-TM-80459; LOG-J12130-Pr-2) Avail: NTIS HC A03/MF A01 CSCL 20D

Newtonian flow theory for unsteady flow past oscillating bodies of revolution at very high Mach numbers is completed by adding a centrifugal force correction to the impact pressures. Exact formulas for the unsteady pressure and the stability derivatives are obtained in closed form and are applicable to bodies of revolution that have arbitrary shapes, arbitrary thicknesses, and either sharp or blunt noses. The centrifugal force correction arising from the curved trajectories followed by the fluid particles in unsteady flow cannot be neglected even for the case of a circular cone. With this correction, the present theory is in excellent agreement with experimental results for sharp cones and for cones with small nose bluntness; gives poor agreement with the results of experiments in air for bodies with moderate or large nose bluntness. The pitching motions of slender power-law bodies of revolution are shown to be always dynamically stable according to Newton-Busemann theory.

A.R.H.

N81-29092* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A VALIDATION OF LTRAN2 WITH HIGH FREQUENCY EXTENSIONS BY COMPARISONS WITH EXPERIMENTAL MEASUREMENTS OF UNSTEADY TRANSONIC FLOWS

Kristin A. Hassenius and Peter M. Goorjian Jul. 1981 24 p refs

(NASA-TM-81307; A-8668) Avail: NTIS HC A02/MF A01 CSCL 01A

A high frequency extension of the unsteady, transonic code LTRAN2 was created and is evaluated by comparisons with experimental results. The experimental test case is a NACA 64A010 airfoil in pitching motion at a Mach number of 0.8 over a range of reduced frequencies. Comparisons indicate that the modified code is an improvement of the original LTRAN2 and provides closer agreement with experimental lift and moment coefficients. A discussion of the code modifications, which involve the addition of high frequency terms of the boundary conditions of the numerical algorithm, is included.

Author

N81-30385* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NUMERICAL INVESTIGATION OF TURBULENT CHANNEL FLOW

Parviz Moin (Stanford Univ., Calif.) and John Kim (Stanford Univ., Calif.) Jul. 1981 73 p refs

(NASA-TM-81309; A-8659) Avail: NTIS HC A04/MF A01 CSCL 20D

Fully developed turbulent channel flow was simulated numerically at Reynolds number 13800, based on centerline velocity and channel half width. The large-scale flow field was obtained by directly integrating the filtered, three dimensional, time dependent, Navier-Stokes equations. The small-scale field motions were simulated through an eddy viscosity model. The calculations were carried out on the ILLIAC IV computer with up to 516,096 grid points. The computed flow field was used to study the statistical properties of the flow as well as its time dependent features. The agreement of the computed mean velocity profile, turbulence statistics, and detailed flow structures with experimental data is good. The resolvable portion of the statistical correlations appearing in the Reynolds stress equations are calculated. Particular attention is given to the examination of the flow structure in the vicinity of the wall.

Author

N81-31289* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FAILURE OF MORPHOLOGY OF (0 DEG)8 GRAPHITE/EPOXY AS INFLUENCED BY ENVIRONMENTS AND PROCESSING

Linda L. Clements and Michael J. Adamson Aug. 1981 25 p refs

(NASA-TM-81318; A-8684) Avail: NTIS HC A02/MF A01 CSCL 11D

Optical and scanning electron microscopy were used to investigate the failure morphology of graphite/epoxy specimens which had been tested until tensile failure. Failure morphology was studied as a function of the quality control variables of specimen preparation technique, prepreg batch, and cure condition, and also as a function of the environmental parameters of temperature and moisture content. Defective specimens were found to exhibit a low energy failure morphology. Poor specimen edge preparation and one batch of prepreg when tested at elevated temperature or moisture content also exhibited energy failure morphology. Postcuring had no effect on strength but did slightly alter failure morphology. Temperature or moisture appeared to decrease flaw sensitivity and thus increase strength; however, moisture also appeared to increase interfacial debonding between filament and matrix. When combined moisture and temperature increased interfacial debonding and made the epoxy matrix more prone to fracture.

Author

N81-31508* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NUMERICAL EXPERIMENTS IN HOMOGENEOUS TURBULENCE

Robert S. Rogallo Sep. 1981 94 p refs

(NASA-TM-81315) Avail: NTIS HC A05/MF A01 CSCL 20D

The direct simulation methods developed by Orszag and Patterson (1972) for isotropic turbulence were extended to homogeneous turbulence in an incompressible fluid subjected to uniform deformation or rotation. The results of simulations for irrotational strain (plane and axisymmetric), shear, rotation, and relaxation toward isotropy following axisymmetric strain are compared with linear theory and experimental data. Emphasis is placed on the shear flow because of its importance and because of the availability of accurate and detailed experimental data. The computed results are used to assess the accuracy of two popular models used in the closure of the Reynolds-stress equations. Data from a variety of the computed fields and the details of the numerical methods used in the simulation are also presented.

Author

NASA CONTRACTOR REPORTS

N81-11109* Virginia Polytechnic Inst. and State Univ., Blacksburg.

CREEP RUPTURE OF POLYMER-MATRIX COMPOSITES

H. F. Brinson, W. I. Griffith, and D. H. Morris Jul. 1980 35 p refs Presented at Fourth SESA Intern. Congr. on Exptl. Mech., Boston, 26-30 May 1980

(Grant NSG-2038)

(NASA-CR-163706; VPI-E-80-18)

Avail: NTIS

HC A03/MF A01 CSCL 11D

An accelerated characterization method for resin matrix composites is reviewed. Methods for determining modulus and strength master curves are given. Creep rupture analytical models are discussed as applied to polymers and polymer matrix composites. Comparisons between creep rupture experiments and analytical models are presented. The time dependent creep rupture process in graphite epoxy laminates is examined as a function of temperature and stress level.

A.R.H.

N81-11110* Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Engineering.

ACCELERATED CHARACTERIZATION OF GRAPHITE/EPOXY COMPOSITES

W. I. Griffith, D. H. Morris, and H. F. Brinson Sep. 1980 28 p refs Presented at the 3d Intern. Conf. on Composite Mater., Paris, 26-29 Aug. 1980 (Grant NSG-2038)
(NASA-CR-163723; VPI-E-80-27) Avail: NTIS HC A03/MF A01 CSCL 11D

A method to predict the long term compliance of unidirectional off-axis laminates from short term laboratory tests is presented. The method uses an orthotropic transformation equation and the time-stress-temperature superposition principle. Short term tests are used to construct master curves for two off-axis unidirectional laminates with fiber angles of 10 and 90 degrees. Analytical predictions of long term compliance for 30 and 60 degrees laminates are made. Comparisons with experimental data are also given. Author

N81-18029*# Arizona Univ., Tucson. College of Engineering. TRANSONIC FLOW STUDIES Final Report, 1 Nov. 1975 - 31 Oct. 1980

Richard A. Seebass and K.-Y. Fung 28 Feb. 1981 230 p refs
(Grant NSG-2112)
(NASA-CR-163965; TFD-81-01) Avail: NTIS HC A10/MF A01 CSCL 01A

Major emphasis was on the design of shock free airfoils with applications to general aviation. Unsteady flow, transonic flow, and shock wave formation were examined. T.M.

N81-18095*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.

DEVELOPMENT OF AN IMPROVED TOUGHNESS HYPER-PURE SILICA REFLECTIVE HEAT SHIELD Contractor Report, 3 Jul. 1978 - 3 Jul. 1979

E. L. Rusert, T. L. Hackett, and D. N. Drennan Aug. 1979 93 p refs
(Contract NAS2-10003)
(NASA-CR-152297) Avail: NTIS HC A05/MF A01 CSCL 11D

High purity three dimensionally woven silica-silica materials were evaluated for use as a tough, reflective heat shield for planetary entry probes. A special weave design was selected to minimize light piping effects through the heat shield thickness. Various weave spacings were evaluated for densification efficiency with an 0.7 micron particle size high purity silica. Spectral hemispherical reflectance was measured from 0.2 to 2.5 microns at room temperature. Reflectance increases due to densification and purity of material were measured. Reflectance of 3D hyperpure silica was higher than 3D astroquartz silica for all wavelengths. Mechanical properties were measured in beam flexure and beam shear tests. Results indicated strengths lower than reported for slip cast fused silica. Low strengths were attributed to low densities achieved through vacuum impregnation. S.F.

N81-18365*# Colorado State Univ., Fort Collins. Dept. of Physics.

VELOCITY MEASUREMENTS BY LASER RESONANCE FLUORESCENCE Final Report

C. Y. She and W. M. Fairbank, Jr. 1980 24 p refs
(Grant NSG-2287)
(NASA-CR-163971) Avail: NTIS HC A02/MF A01 CSCL 20E

The photonburst correlation method was used to detect single atoms in a buffer gas. Real time flow-velocity measurements with laser induced resonance fluorescence from single or multiple atoms was demonstrated and this method was investigated as a tool for wind tunnel flow measurement. Investigations show that single atoms and their real time diffusional motion on a buffer gas can be measured by resonance fluorescence. By averaging over many atoms, flow velocities up to 88 m/s were measured in a time of 0.5 sec. It is expected that higher flow

speeds can be measured and that the measurement time can be reduced by a factor of 10 or more by careful experimental design. The method is clearly not ready for incorporation in high speed wind tunnels because it is not yet known whether the stray light level will be higher or lower, and it is not known what detection efficiency can be obtained in a wind tunnel situation. A.R.H.

N81-19020*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

UNSTEADY TRANSONIC SMALL DISTURBANCE THEORY WITH STRONG SHOCK WAVES

G. David Kerlick, David Nixon, and William F. Ballhaus, Jr. Sep. 1980 22 p refs
(NASA Order A-70215-B; NASA Order A-77455-B)
(NASA-CR-166157; NEAR-TR-230) Avail: NTIS HC A02/MF A01 CSCL 01A

A theory to correct the transonic small disturbance (TSD) equation to treat strong shock waves in unsteady flow is developed. The technique involves the addition of higher order terms, which are formally of negligible magnitude, to the low frequency TSD equation. These terms are then chosen such that any shock waves in the flow have strengths approximately equal to the appropriate Rankine-Hugoniot shock strength. Two correcting approaches are investigated. The first is to derive a correction for the mean steady flow and then simply use this corrected form for oscillatory flows. The second is to derive a correction for both steady and oscillatory parts of the flow. This second development is the most satisfactory and comparisons of the present results with Euler equation results are generally favorable, particularly regarding shock location, although there are some discrepancies in the pressure distribution in the leading edge region. M.G.

N81-19881*# Battelle Columbus Labs., Ohio.

QUANTUM CHEMICAL CALCULATION OF THE EQUILIBRIUM STRUCTURES OF SMALL METAL ATOM CLUSTERS Annual Progress Report, 1 Apr. 1980 - 29 Feb. 1981

Luis R. Kahn 27 Mar. 1981 78 p refs
(Grant NSG-2027)
(NASA-CR-164035) Avail: NTIS HC A05/MF A01 CSCL 20H

A decomposition of the molecular energy is presented that is motivated by the atom superposition and electron delocalization physical model of chemical binding. The energy appears in physically transparent form consisting of a classical electrostatic interaction, a zero order two electron exchange interaction, a relaxation energy, and the atomic energies. Detailed formulae are derived in zero and first order of approximation. The formulation extends beyond first order to any chosen level of approximation leading, in principle, to the exact energy. The structure of this energy decomposition lends itself to the fullest utilization of the solutions to the atomic sub problems to simplify the calculation of the molecular energy. If nonlinear relaxation effects remain minor, the molecular energy calculation requires at most the calculation of two center, two electron integrals. This scheme thus affords the prospects of substantially reducing the computational effort required for the calculation of molecular energies. M.G.

N81-20641*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

DENSITY MEASUREMENT IN AIR WITH A SATURABLE ABSORBING SEED GAS Semiannual Progress Report, 1 Jul. - 31 Dec. 1980

Donald Baganoff Mar. 1981 44 p refs
(Grant NAG2-36)
(NASA-CR-164063) Avail: NTIS HC A03/MF A01 CSCL 04A

Resonantly enhanced scattering from the iodine molecule is studied experimentally for the purpose of developing a scheme for the measurement of density in a gas dynamic flow. A study

of the spectrum of iodine, the collection of saturation data in iodine, and the development of a mathematical model for correlating saturation effects were pursued for a mixture of 0.3 torr iodine in nitrogen and for mixture pressures up to one atmosphere. For the desired pressure range, saturation effects in iodine were found to be too small to be useful in allowing density measurements to be made. The effects of quenching can be reduced by detuning the exciting laser wavelength from the absorption line center of the iodine line used (resonant Raman scattering). The signal was found to be nearly independent of pressure, for pressures up to one atmosphere, when the excitation beam was detuned 6 GHz from line center for an isolated line in iodine. The signal amplitude was found to be nearly equal to the amplitude for fluorescence at atmospheric pressure, which indicates a density measurement scheme is possible. M.G.

N81-23193* Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.

CREEP AND CREEP RUPTURE OF LAMINATED GRAPHITE/EPOXY COMPOSITES Ph.D. Thesis. Final Report, 1 Oct. 1979 - 30 Sep. 1980

D. A. Dillard (Missouri Univ., Rolla), D. H. Morris, and H. F. Brinson Mar. 1981 47 p refs

(Contract NCC2-71; Grant NsG-2038)

(NASA-CR-164297; VPI-E-81-3)

Avail: NTIS

HC A03/MF A01 CSCL 11D

An incremental numerical procedure based on lamination theory is developed to predict creep and creep rupture of general laminates. Existing unidirectional creep compliance and delayed failure data is used to develop analytical models for lamina response. The compliance model is based on a procedure proposed by Findley which incorporates the power law for creep into a nonlinear constitutive relationship. The matrix octahedral shear stress is assumed to control the stress interaction effect. A modified superposition principle is used to account for the varying stress level effect on the creep strain. The lamina failure model is based on a modification of the Tsai-Hill theory which includes the time dependent creep rupture strength. A linear cumulative damage law is used to monitor the remaining lifetime in each ply. E.D.K.

N81-23415* Princeton Univ., N. J. Gas Dynamics Lab.
COMPRESSIBLE TURBULENT BOUNDARY LAYER INTERACTION EXPERIMENTS Final Technical Report, 1 Feb. 1978 - 31 Jan. 1981

Gary S. Settles and Seymour M. Bogdonoff May 1981 37 p refs

(Grant NsG-2299; Contracts F44620-75-C-0080; F49620-80-C-0092)

(NASA-CR-164292; MAE-1525)

Avail: NTIS

HC A03/MF A01 CSCL 20D

Four phases of research results are reported: (1) experiments on the compressible turbulent boundary layer flow in a streamwise corner; (2) the two dimensional (2D) interaction of incident shock waves with a compressible turbulent boundary layer; (3) three dimensional (3D) shock/boundary layer interactions; and (4) cooperative experiments at Princeton and numerical computations at NASA-Ames. S.F.

N81-25038* Grumman Aerospace Corp., Bethpage, N.Y.
AN ALTERNATING-DIRECTION-IMPLICIT ALGORITHM FOR THE UNSTEADY POTENTIAL EQUATION IN CONSERVATION FORM Final Report

Richard R. Chipman Jul. 1980 43 p refs

(Contract NAS2-10487)

(NASA-CR-166152) Avail: NTIS HC A03/MF A01 CSCL 01A

An implicit finite difference scheme for an efficient computation of unsteady potential flow about airfoils is presented. The formulation uses density and velocity potential as dependent variables, and is cast in conservation form to assure the

theoretically correct determination of shockwave location and speed. To enable boundary conditions to be imposed directly on the airfoil surface, a time varying sheared rectilinear coordinate transformation is employed. Calculated time history solutions on a pulsating airfoil are compared with the results of another unsteady transonic code. It is concluded that the method has excellent numerical stability and gives accurate solutions with sharply resolved shocks. E.A.K.

N81-25131* Martin Marietta Corp., Denver, Colo.

INFRARED IMAGERY OF SHUTTLE (IRIS). TASK 2, SUMMARY REPORT

Clifford J. Choccol Jan. 1978 16 p refs

(Contract NAS2-9381)

(NASA-CR-152123-Task-2-Summ; MCR-76-564-Task-2-Summ)

Avail: NTIS HC A02/MF A01 CSCL 22B

End-to-end tests of a 16 element indium antimonide sensor array and 10 channels of associated electronic signal processing were completed. Quantitative data were gathered on system responsivity, frequency response, noise, stray capacitance effects, and sensor paralleling. These tests verify that the temperature accuracies, predicted in the Task 1 study, can be obtained with a very carefully designed electro-optical flight system. Pre-flight and inflight calibration of a high quality are mandatory to obtain these accuracies. Also, optical crosstalk in the array-dewar assembly must be carefully eliminated by its design. Tests of the scaled up tracking system reticle also demonstrate that the predicted tracking system accuracies can be met in the flight system. In addition, improvements in the reticle pattern and electronics are possible, which will reduce the complexity of the flight system and increase tracking accuracy. Author

N81-25132* Martin Marietta Corp., Denver, Colo.

INFRARED IMAGERY OF SHUTTLE (IRIS). TASK 1 Final Report

Clifford J. Choccol Aug. 1977 151 p refs

(Contract NAS2-9381)

(NASA-CR-152123-Task-1-Final; MCR-76-564-Task-1-Final)

Avail: NTIS HC A08/MF A01 CSCL 22B

Assessment of available IR sensor technology showed that the four aerothermodynamic conditions of interest during the entry trajectory of space shuttle can be accommodated by an aircraft flying parallel to the orbiter reentry ground track. Thermal information from the sides of the vehicle can be obtained with degraded performance (temperatures below 800 K) by flying the C-141 aircraft on the opposite side of the shuttle ground track and in the direction opposite that which is optimum for lower surface viewing. An acquisition system using a 6.25-cm aperture telescope and a single indium antimonide detector were designed to meet the acquisition requirements and interface with the 91.5-cm telescope with minimum modification. An image plane system using 600 indium antimonide detectors in two arrays which requires no modification to the existing telescope was also designed. Currently available components were used in a data handling system with interfaces with the experimenters station and the HP2100 computer. A.R.H.

N81-25133* Martin Marietta Corp., Denver, Colo.

INFRARED IMAGERY OF SHUTTLE (IRIS). TASK 2 Final Report

Clifford J. Choccol Jan. 1978 58 p refs

(Contract NAS2-9381)

(NASA-CR-152123-Task-2-Final; MCR-76-564-Task-2-Final)

Avail: NTIS HC A04/MF A01 CSCL 22B

An opto-electronic breadboard of 10 channels of the IR temperature measuring system was produced as well as a scaled up portion of the tracking system reticle in order to verify Task 1 assumptions. The breadboards and the tests performed on them are described and both raw and reduced data are presented. Tests show that the electronics portion of the imaging system

will provide a dc to 10,000 Hz bandwidth that is flat and contributes no more than 0.4% of full-scale uncertainty to the measurement. Conventional packaging is adequate for the transresistance amplifier design. Measurement errors expected from all sources tested are discussed. A.R.H.

N81-26430* Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mining and Minerals Engineering.
NEAR-WALL SIMILARITY IN A PRESSURE-DRIVEN THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER
 F. J. Pierce and J. E. McAllister Sep. 1980 242 p refs (Grant NsG-2301)
 (NASA-CR-164421; PB81-156960; VPI-E-80.32) Avail: NTIS HC A11/MF A01 CSDL 20D

Mean velocity, measured wall pressure and wall shear stress fields were made in a three dimensional pressure-driven turbulent boundary layer created by a cylinder with trailing edge placed normal to a flat plate floor. The direct force wall shear stress measurements were made with floating element direct force sensing shear meter that responded to both the magnitude and direction of the local wall shear stress. The ability of 10 near wall similarity models to describe the near wall velocity field for the measured flow under a wide range of skewing conditions and a variety of pressure gradient and wall shear vector orientations was used. GRA

N81-27435* Westinghouse Research and Development Center, Pittsburgh, Pa.
HEAT PUMP PROCESSES INDUCED BY LASER RADIATION
Final Report, 15 Oct. 1978 - 30 Apr. 1980
 M. Garbuny and T. Henningsen 3 Jun. 1980 43 p refs (Contract NAS2-10078)
 (NASA-CR-166205) Avail: NTIS HC A03/MF A01 CSDL 20D

A carbon dioxide laser system was constructed for the demonstration of heat pump processes induced by laser radiation. The system consisted of a frequency doubling stage, a gas reaction cell with its vacuum and high purity gas supply system, and provisions to measure the temperature changes by pressure, or alternatively, by density changes. The theoretical considerations for the choice of designs and components are discussed. R.C.T.

N81-33272* Battelle Columbus Labs., Ohio.
QUANTUM CHEMICAL CALCULATION OF THE EQUILIBRIUM STRUCTURES OF SMALL METAL ATOM CLUSTERS
Semiannual Progress Report, 15 Apr. - 30 Oct. 1981
 Luis R. Kahn 23 Oct. 1981 33 p refs (Grant NsG-2027)
 (NASA-CR-164874) Avail: NTIS HC A03/MF A01 CSDL 11F

The application of ab initio quantum mechanical approaches in the study of metal atom clusters requires simplifying techniques that do not compromise the reliability of the calculations. Various aspects of the implementation of the effective core potential (ECP) technique for the removal of the metal atom core electrons from the calculation were examined. The ECP molecular integral formulae were modified to bring out the shell characteristics as a first step towards fulfilling the increasing need to speed up the computation of the ECP integrals. Work on the relationships among the derivatives of the molecular integrals that extends some of the techniques pioneered by Komornicki for the calculation of the gradients of the electronic energy was completed and a formulation of the ECP approach that quite naturally unifies the various state-of-the-art 'shape- and Hamiltonian-consistent' techniques was discovered. A.R.H.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-10487 * Vortex methods for flow simulation. A. Leonard (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Computational Physics*, vol. 37, Oct. 1980, p. 289-335. 64 refs.

Recent progress in the development of vortex methods and their applications to the numerical simulation of incompressible fluid flows are reviewed. Emphasis is on recent results concerning the accuracy of these methods, improvements in computational efficiency, and the development of three-dimensional methods. Simulations of several example flows which display some of the strengths and weaknesses of vortex methods are presented. (Author)

N81-15313* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
VORTEX METHODS FOR TWO- AND THREE-DIMENSIONAL FLOW SIMULATIONS

A. Leonard In *Von Karman Inst. for Fluid Dyn. Computational Fluid Dyn.*, Vol. 2 1980 52 p refs (For primary document see N81-15310 06-34)

Avail: NTIS HC A17/MF A01

The point vortex and vortex blob methods for two dimensional flows are presented. Several results are discussed concerning the numerical analysis of the latter scheme, e.g., the preservation of globally conserved quantities and the analysis of the spatial discretization error resulting from the convection of fixed blobs of vorticity. An application to the two dimensional mixing layer is briefly described. The contour dynamics method is also discussed. The simulation of three dimensional flows with vortex methods is discussed. A natural way to represent the vorticity is in the form of closed tubes of filaments of vorticity, although other schemes are examined. Applications to aircraft trailing vortices and to a turbulent spot in a laminar boundary layer are presented. Hybrid schemes that use an Eulerian mesh to solve the Poisson equation for the velocity field are discussed. The goal of these schemes is to avoid the high cost of the Biot-Savart integration if many vortex elements are used while enjoying most of the advantages of pure Lagrangian schemes. R.C.T.

A81-15474 * Effects due to proximity-induced electric dipole moments on Br + H₂ collisions in an intense laser field. I. H. Zimmerman (Clarkson College of Technology, Potsdam, N.Y.), J. R. Stallcop, B. C. F. M. Laskowski (NASA, Ames Research Center, Moffett Field, Calif.), and T. F. George. *Chemical Physics*, vol. 49, 1980, p. 59-64. 9 refs. Grant No. NsG-2198.

A81-15747 * Energy-selective SESD imaging utilizing a CMA. L. A. Larson (NASA, Ames Research Center; Stanford Joint Institute for Surface and Microstructure Research, Moffett Field, Calif.; Washington State University, Pullman, Wash.), F. Soria (NASA, Ames Research Center; Stanford Joint Institute for Surface and Microstructure Research, Moffett Field, Calif.; Consejo Superior de Investigaciones Cientificas, Instituto de Fisica de Materiales, Madrid, Spain), and H. Poppa (NASA, Ames Research Center; Stanford Joint Institute for Surface and Microstructure Research, Moffett Field, Calif.). *Journal of Vacuum Science and Technology*, vol. 17, Nov.-Dec. 1980, p. 1364-1366. 10 refs. Grant No. NCA2-OR-840-901.

A particularly simple conversion of a scanning Auger system for ESD ion energy distributions and scanning ESD has been developed. This approach combines the advantages of the small spot-size electron guns and mapping systems developed for SAM with the capability of ESD for the detection of hydrogen. Our intended use for the device is detection and mapping of surface concentrations of

hydrogen on metals. The characteristics of SEDS are illustrated with the preliminary results of an investigation into the SED properties of hydrogenic adsorbates on Nb. It is shown that the SEDIED exhibit distinct differences indicative of the surface preparation, and that the SED ion angular distributions have an effect on the observed contrast relationships in SEDS. (Author)

A81-15900 * # Thin-layer approximation for three-dimensional supersonic corner flows. C. M. Hung and S. S. Kurasaki (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA Journal*, vol. 18, Dec. 1980, p. 1544-1546. 12 refs.

The thin-layer approximation is extended to an axial corner that is formed by the intersection of two perpendicular plates, one of which has an inclination angle with respect to the free stream. A computer code developed by Hung and McCormack (1978) is modified for the thin-layer approximation, and a case with Mach 5.9 and a wedge angle of 6 deg is computed. In addition, it is shown that it is not necessary to solve the complete Navier-Stokes equations for a three-dimensional high-Reynolds-number corner flow. B.J.

A81-15987 * Developments in fibrous refractory composite insulation. D. B. Leiser, M. Smith, and H. E. Goldstein (NASA, Ames Research Center, Moffett Field, Calif.). (*American Ceramic Society, Annual Conference on Composites and Advanced Materials, 4th, Cocoa Beach, Fla., Jan. 20-24, 1980.*) *Ceramic Engineering and Science Proceedings*, vol. 1, no. 7-8 (B), July-Aug. 1980, p. 649-660. 13 refs.

The development of a new insulation material for heat-shielding advanced reusable entry vehicles is reported. The material, called fibrous refractory composite insulation, is a composite of two ceramic fibers with no additional additives to bond the fibers together; it also includes silicon carbide, an emittance agent, to improve its optical properties at high temperature. One fiber is a drawn 11-micron-diameter aluminoborosilicate fiber, the other fiber is the silica fiber (microquartz) used in producing silica RSI (reusable surface insulation for the Space Shuttle), which is a blown fiber of 1-3 micron diameter and variable length. A composition containing 20%, with a thermal shock resistance of 1.8 that of all silica insulation, has been successfully produced in a pilot plant. V.L.

A81-16703 * Photoexcitation and ionization in carbon dioxide - Theoretical studies in the separated-channel static-exchange approximation. N. Padial, G. Csanak (Campinas, Universidade Estadual, Campinas, São Paulo, Brazil), B. V. McKoy (California Institute of Technology, Pasadena, Calif.), and P. W. Langhoff (NASA, Ames Research Center, Computational Chemistry Group, Moffett Field, Calif.; Indiana University, Bloomington, Ind.). *Physical Review A - General Physics, 3rd Series*, vol. 23, Jan. 1981, p. 218-235. 84 refs. Research supported by the Conselho Nacional de Pesquisas, Fundação de Amparo à Pesquisa do Estado de São Paulo, Petroleum Research Fund, NSF, and NASA.

Vertical-electronic static-exchange photoexcitation and ionization cross sections are reported which provide a first approximation to the complete dipole spectrum of CO₂. Separated-channel static-exchange calculations of vertical-electronic transition energies and oscillator strengths, and Stieltjes-Chebyshev moment methods were used in the development. Detailed comparisons were made of the static-exchange excitation and ionization spectra with photoabsorption, electron-impact excitation, and quantum-defect estimates of discrete transition energies and intensities, and with partial-channel photoionization cross sections obtained from fluorescence measurements and from tunable-source and (e, 2e) photoelectron spectroscopy. Results show that the separate-channel static-exchange approximation is generally satisfactory in CO₂. B.J.

A81-23769 * A theoretical study of selected singlet and triplet states of CO molecule. D. M. Cooper and S. R. Langhoff (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Chemical Physics*, vol. 74, Jan. 15, 1981, p. 1200-1210. 68 refs.

The results of the configuration calculations of six singlet electronic states and one triplet electronic state of CO are presented. The potential energy curves, spectroscopic constants, and electron transition moments are calculated, along with electronic dipole moment functions for three states. The self-consistent field and configuration calculations used to obtain the electronic wave functions are described. The theoretical results are found to be in good agreement with the experimental measurements, and in the case of the dipole moment function calculations, preferable to them. L.S.

A81-24725 * Semiclassical study of the quenching of excited-state fluorine atom by hydrogen molecule - Comparison between reactive and nonreactive processes. J.-M. Yuan (Drexel University, Philadelphia, Pa.), B. M. Skuse (Rochester University, Rochester, N.Y.), R. L. Jaffe, A. Komornicki (NASA, Ames Research Center, Moffett Field, Calif.), K. Morokuma (Institute for Molecular Science, Okazaki, Japan), and T. F. George. *Israel Journal of Chemistry*, vol. 19, 1980, p. 337-339. 14 refs. NSF Grant No. CHE-77-27826; Contract No. F49620-78-C-0005; Grant No. NSG-2198.

Semiclassical calculations are carried out for the quenching of excited-state fluorine atom by collinear collisions with hydrogen molecule. The overall quenching probability is the sum of two contributions: the reactive quenching probability associated with the formation of hydrogen fluoride and the nonreactive quenching probability leading to ground-state fluorine atom and hydrogen molecule. The reactive probability is greater in the threshold region of the collision energy, whereas the nonreactive probability dominates for energies above the threshold region. (Author)

A81-25512 * # Unsteady Newton-Busemann flow theory. I - Airfoils. W. H. Hui and M. Tobak (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA Journal*, vol. 19, Mar. 1981, p. 311-318. 9 refs.

Newtonian flow theory for unsteady flow at very high Mach numbers is completed by the addition of a centrifugal force correction to the impact pressures. The correction term is the unsteady counterpart of Busemann's centrifugal force correction to impact pressures in steady flow. For airfoils of arbitrary shape, exact formulas for the unsteady pressure and stiffness and damping-in-pitch derivatives are obtained in closed form, which require only numerical quadratures of terms involving the airfoil shape. They are applicable to airfoils of arbitrary thickness having sharp or blunt leading edges. For wedges and thin airfoils these formulas are greatly simplified, and it is proved that the pitching motions of thin airfoils of convex shape and of wedges of arbitrary thickness are always dynamically stable according to Newton-Busemann theory. Leading-edge bluntness is shown to have a favorable effect on the dynamic stability; on the other hand, airfoils of concave shape tend toward dynamic instability over a range of axis positions if the surface curvature exceeds a certain limit. As a byproduct, it is also shown that a pressure formula recently given by Barron and Mandl for unsteady Newtonian flow over a pitching power-law shaped airfoil is erroneous and that their conclusion regarding the effect of pivot position on the dynamic stability is misleading. (Author)

A81-26834 * # Performance of entry heat shields on Pioneer Venus probes. W. C. Pitts and R. M. Wakefield (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 8333-8337. 7 refs.

The Pioneer Venus probes approached Venus with high relative velocity. As they entered the atmosphere, they were rapidly decelerated by aerodynamic drag, and a great deal of heat was generated. To protect the probe structure and the scientific instruments, a carbon phenolic heat shield was placed on the front of the probes. Because the design of heat shields for planetary entry is a developing technology, thermocouples were placed in the heat shields so that actual and predicted heat shield performance could be compared. The function of the heat shield is discussed, the probe environments during entry into the Venusian atmosphere are described, and some results from the heat shield experiment are presented. It was found that for the most part, the heat shields performed better than expected. (Author)

A81-34845 * **Ab initio calculation of the X 1 Sigma + and A 1 Sigma + states of CsH.** B. Laskowski (NASA, Ames Research Center; Stanford Joint Institute for Surface and Microstructural Research, Moffett Field, Calif.) and J. R. Stallcop (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Chemical Physics*, vol. 74, May 1, 1981, p. 4883-4887. 29 refs.

A81-37230 * **Flux vector splitting of the inviscid gasdynamic equations with application to finite-difference methods.** J. L. Steger and R. F. Warming (NASA, Ames Research Center, Computational Fluid Dynamics Branch, Moffett Field, Calif.). *Journal of Computational Physics*, vol. 40, Apr. 1981, p. 263-293. 32 refs.

The conservation-law form of the inviscid gasdynamic equations has the remarkable property that the nonlinear flux vectors are homogeneous functions of degree one. This property readily permits the splitting of flux vectors into subvectors by similarity transformations so that each subvector has associated with it a specified eigenvalue spectrum. As a consequence of flux vector splitting, new explicit and implicit dissipative finite-difference schemes are developed for first-order hyperbolic systems of equations. Appropriate one-sided spatial differences for each split flux vector are used throughout the computational field even if the flow is locally subsonic. The results of some preliminary numerical computations are included. (Author)

A81-37847 * # **Two-photon excitation of nitric oxide fluorescence as a temperature indicator in unsteady gasdynamic processes.** R. L. McKenzie (NASA, Ames Research Center, Moffett Field, CA) and K. P. Gross (Stanford University, Stanford, CA). *Applied Optics*, vol. 20, June 15, 1981, p. 2153-2165. 41 refs. Contract No. NAS2-10351.

A laser-induced fluorescence technique based on the pulsed two-photon excitation of NO is presented which is especially suited for the measurement of fluctuating temperatures in cold turbulent flows. The technique uses the fluorescence from the UV gamma bands of NO produced by two-photon excitation of NO ($A^2\Sigma^+$, ν -prime = 0 - $X^2\Pi$, ν -double prime = 0) to obtain a rotational temperature. An analysis is presented of relevant aspects of the two-photon absorption process including microphysical processes, spectral intensities as a function of transition and laser spectral widths, line-shape integrals, the nonequilibrium response of the medium to a laser pulse, fluorescence energies, signal to noise ratio, and focusing effects. An analysis of absolute two-photon absorptivity measured in a nonflowing cell is then presented and used to predict signal to noise ratios greater than 50 for supersonic flows at temperatures below 300 K. A.L.W.

A81-38824 * **Ab Initio calculation of the third-order susceptibility of H₂.** W. M. Huo and R. L. Jaffe (NASA, Ames Research

Center, Moffett Field, CA). *Physical Review Letters*, vol. 47, July 6, 1981, p. 30-34. 18 refs.

The third-order susceptibility of H₂ has been calculated under coherent anti-Stokes Raman-scattering conditions, with use of wave functions specifically designed for accurate calculations of sum-rule properties. The theoretical values are in good agreement with experiment. (Author)

A81-41704 * **Theoretical calculation of low-lying states of NaAr and NaXe.** B. C. Laskowski (NASA, Ames Research Center, Moffett Field; Surface Analytic Research, Inc., Mountain View, CA), S. R. Langhoff, and J. R. Stallcop (NASA, Ames Research Center, Moffett Field, CA). *Journal of Chemical Physics*, vol. 75, July 15, 1981, p. 815-827. 36 refs. Contract No. NAS2-10595.

Potential curves as well as dipole moments and linking transition moments are calculated for the ground $X^2\Sigma^+$ and low lying excited $A^2\Pi$, $B^2\Sigma^+$, $C^2\Sigma^+$, $(4)^2\Sigma^+$, $(2)^2\Pi$ and $(1)^2\Delta$ states of NaAr and NaXe. Calculations are performed using a self-consistent field plus configuration-interaction procedure with the core electrons replaced by an ab initio effective core potential. The potential curves obtained are found to be considerably less repulsive than the semiempirical curves of Pascale and Vandepanque (1974) and to agree well with existing experimental data, although the binding energies of those states having potential minima due to van der Waals interactions are underestimated. Emission bands are also calculated for the $X^2\Sigma^+ - C^2\Sigma^+$ excimer transitions of NaAr and NaXe using the calculated transition moments and potential curves, and shown to agree well with experiment on the short-wavelength side of the maximum. A.L.W.

A81-44049 * **Theoretical electronic transition moments for the Ballik-Ramsay, Fox-Herzberg, and Swan systems of C₂.** D. M. Cooper (NASA, Ames Research Center, Moffett Field, CA). *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 26, Aug. 1981, p. 113-118. 20 refs.

Electronic transition moments and their variation with internuclear separation are calculated for the Ballik-Ramsay ($b^3\Sigma^+g - a^3\Pi u$), Fox-Herzberg ($e^3\Pi g-a^3\Pi u$) and Swan ($d^3\Pi g-a^3\Pi u$) band systems of C₂, which appear in a variety of terrestrial and astrophysical sources. Electronic wave functions of the $a^3\Pi u$, $b^2\Sigma^+g$, $d^3\Pi g$ and $e^3\Pi g$ states of C₂ are obtained by means of a self-consistent field plus configuration interaction calculation using an atomic basis of 46 Slater-type orbitals, and theoretical potential energy curves and spectroscopic constants for the four electronic states were computed. The results obtained for both the potential energy curves and electronic transition moments are found to be in good agreement with experimental data. A.L.W.

A81-45100 * **Influence of hydrogen chemisorption kinetics on the interpretation of hydrogen transport through iron membranes.** M. R. Shanabarger (California, University, Santa Barbara, CA), A. Taslami (Foothill-DeAnza Community College, Los Altos Hills, CA), and H. G. Nelson (NASA, Ames Research Center, Moffett Field, CA). *Scripta Metallurgica*, vol. 15, Aug. 1981, p. 929-933. 10 refs. Grant No. NCC2-63.

The influence of a specific surface reaction on the transport of gas-phase hydrogen through iron membranes has been investigated on the basis of model calculations. The surface reaction involves an adsorbed molecular hydrogen precursor between the gas phase and the dissociated chemisorbed state. The calculations demonstrate that the surface reaction for the H₂/Fe system makes significant contributions to the time delay associated with the transient hydrogen transport through iron membranes, even under conditions where the steady-state hydrogen transport is independent of the surface reaction. These contributions to the time delay are interpreted in terms of an effective diffusivity, which is a function of the pressure on the entrance side and the thickness of the membrane. G.R.

A81-45253 * Theoretical study of the dipole moment function of the $A\ 1\ \Sigma +$ state of LiH. H. Partridge, S. R. Langhoff (NASA, Ames Research Center, Moffett Field, CA), W. C. Stwalley (Iowa, University, Iowa City, IA), and W. T. Zemke. *Journal of Chemical Physics*, vol. 75, Sept. 1, 1981, p. 2299-2305. 19 refs. NASA-NSF-supported research.

A81-47895 * Effect of particle size on the chemisorption and decomposition of carbon monoxide by palladium and nickel clusters. D. L. Doering, H. Poppa (NASA, Ames Research Center; Stanford Joint Institute for Surface and Microstructure Research, Moffett Field, CA), and J. T. Dickinson (Washington State University, Pullman, WA). *Journal of Vacuum Science and Technology*, vol. 18, Mar. 1981, p. 460-462. 10 refs. Grant No. NCA2-OR-840-801.

The chemisorption of gases on well-defined, supported metal particles is a model for basic processes in heterogeneous catalysis. In this study, the chemisorption and decomposition of carbon monoxide on palladium and nickel particles was examined as a function of particle size. Particulate films with average particle sizes ranging from 1 to 10 nm were grown by vapor deposition on UHV-cleaved mica. Successive CO adsorption-desorption cycles resulted in the accumulation of carbon on the particles, which suppressed CO adsorption. The rate of carbon accumulation was strongly dependent on particle size and was higher for Ni than for Pd over the same size range. Carbon was removed from both metals by oxygen treatments at elevated temperatures. However, a mixture of CO and O₂ was effective for monitoring the removal of carbon from palladium. (Author)

A81-49077 * # Unsteady Newton-Busemann flow theory. II - Bodies of revolution. W. H. Hui and M. Tobak (NASA, Ames Research Center, Moffett Field, CA). *AIAA Journal*, vol. 19, Oct. 1981, p. 1272, 1273. 9 refs.

A complete Newtonian flow theory is presented for unsteady flow past oscillating bodies of revolution of general shape at very high Mach numbers, consideration being given to a centrifugal force correction to the impact pressures. Expressions are obtained for the unsteady pressure and the stability derivatives are presented in closed form. It is stressed that the correction for the centrifugal force, which arises because of the curved trajectories that fluid particles follow along the surface subsequent to their impact, must not be neglected. If the correction is included, the theory is shown to be in excellent agreement with experimental results for relatively sharp cones. Theoretical results are in poor agreement with experimental results in air for bodies having moderate or large-nose bluntness. K.S.

CONFERENCE AND MEETING PAPERS

N81-14722*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NUMERICAL GENERATION OF TWO-DIMENSIONAL GRIDS BY THE USE OF POISSON EQUATIONS WITH GRID CONTROL AT BOUNDARIES

Reese L. Sorenson and Joseph L. Steger. In NASA. Langley Research Center Numerical Grid Generation Tech. 1980 p. 449-462. Prepared in cooperation with Flow Simulations, Inc., Sunnyvale, Calif. (For primary document see N81-14690 05-64) Avail: NTIS HC A24/MF A01 CSCL 12A

A method for generating boundary-fitted, curvilinear, two dimensional grids by the use of the Poisson equations is presented. Grids of C-type and O-type were made about airfoils and other shapes, with circular, rectangular, cascade-type, and other outer boundary shapes. Both viscous and inviscid spacings were used. In all cases, two important types of grid control can be exercised at both inner and outer boundaries. First is arbitrary control of the distances between the boundaries and the adjacent lines of the same coordinate family, i.e., stand-off distances. Second is

arbitrary control of the angles with which lines of the opposite coordinate family intersect the boundaries. Thus, both grid cell size (or aspect ratio) and grid cell skewness are controlled at boundaries. Reasonable cell size and shape are ensured even in cases wherein extreme boundary shapes would tend to cause skewness or poorly controlled grid spacing. An inherent feature of the Poisson equations is that lines in the interior of the grid smoothly connect the boundary points (the grid mapping functions are second order differentiable). M.G.

N81-14723*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

USE OF HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS TO GENERATE BODY FITTED COORDINATES

Joseph L. Steger and Reese L. Sorenson. In NASA. Langley Research Center Numerical Grid Generation Tech. 1980 p. 463-478. Prepared in cooperation with Flow Simulations, Inc., Sunnyvale, Calif. (For primary document see N81-14690 05-64) Avail: NTIS HC A24/MF A01 CSCL 12A

The hyperbolic scheme is used to efficiently generate smoothly varying grids with good step size control near the body. Although only two dimensional applications are presented, the basic concepts are shown to extend to three dimensions. R.C.T.

N81-16018*# Nielsen Engineering and Research, Inc., Mountain View, Calif.

DATA BASE FOR THE PREDICTION OF INLET EXTERNAL DRAG

O. J. McMillan, E. W. Perkins, and S. C. Perkins, Jr. In AGARD Subsonic/Transonic Configuration Aerodyn. Sep. 1980 23 p refs (For primary document see N81-15991 07-02) (Contracts NAS2-8874; NAS2-9513)

Avail: NTIS HC A19/MF A01 CSCL 01A

Results are presented from a study to define and evaluate the data base for predicting an airframe/propulsion system interference effect shown to be of considerable importance, inlet external drag. The study is focused on supersonic tactical aircraft with highly integrated jet propulsion systems, although some information is included for supersonic strategic aircraft and for transport aircraft designed for high subsonic or low supersonic cruise. The data base for inlet external drag is considered to consist of the theoretical and empirical prediction methods as well as the experimental data identified in an extensive literature search. The state of the art in the subsonic and transonic speed regimes is evaluated. The experimental data base is organized and presented in a series of tables in which the test article, the quantities measured and the ranges of test conditions covered are described for each set of data; in this way, the breadth of coverage and gaps in the existing experimental data are evident. Prediction methods are categorized by method of solution, type of inlet and speed range to which they apply, major features are given, and their accuracy is assessed by means of comparison to experimental data. Author

A81-20565 * # Numerical solution of supersonic viscous flow over blunt delta wings. J. C. Tannehill, E. Venkatapathy (Iowa State University of Science and Technology, Ames, Iowa), and J. V. Rakich (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0049*. 19 p. 22 refs. Research supported by the Iowa State University of Science and Technology; Grant No. NGR-16-002-038.

A general parabolized Navier-Stokes code has been developed to compute the steady supersonic viscous flow around arbitrary body shapes at high angles of attack. A nonorthogonal three-dimensional coordinate frame permits the code to march with solution surfaces which are the most appropriate. The code has been used to calculate the laminar flow over a slab delta wing with 70 deg sweep at angles of attack up to 41.5 deg and Mach numbers of 6.8 and 9.6. The computed shock shapes, surface pressures and heat transfer coefficients are compared with experiment and show agreement. (Author)

A81-20566 * # A numerical simulation of hypersonic viscous flow over arbitrary geometries at angle of attack. D. S. Chaussee, P. Kutler, T. H. Pulliam (NASA, Ames Research Center, Moffett Field, Calif.), J. L. Patterson (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio), and J. L. Steger (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0050.* 15 p. 25 refs. Contract No. F33615-79-C-3001.

An implicit conservative, noniterative, finite-difference algorithm that predicts the supersonic, laminar or turbulent viscous flow about arbitrary geometries at large angles of attack is presented. The three-dimensional parabolized form of the thin-layer Navier-Stokes equations are written in generalized coordinates. These equations are solved using the delta form of the Beam-Warming implicit algorithm. Flow field simulations have been obtained for a blunt biconic with windward and leeward cuts and an X-24C lifting body for both laminar and turbulent flow at various Mach numbers and angles of attack. When compared with experiment or with previous theories, these computational predictions show good agreement. (Author)

A81-20611 * # A numerical method for solving the equations of compressible viscous flow. R. W. MacCormack (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0110.* 10 p. 5 refs.

Although much progress has already been made in solving problems in aerodynamic design, many new developments are still needed before the equations for unsteady compressible viscous flow can be solved routinely. This paper describes one such development. A method for solving these equations has been devised that: (1) is second-order accurate in space and time; (2) is unconditionally stable; (3) preserves conservation form; (4) requires no block or scalar tridiagonal inversions; (5) is simple and straightforward to program (estimated 10% modification for the update of many existing programs); (6) is more efficient than present methods; and (7) should easily adapt to current and future computer architectures. Computational results for laminar and turbulent flows at Reynolds numbers from 300,000 to 3×10^6 and at CFL numbers as high as 1000 are compared with theory and experiment. (Author)

A81-20725 * # Forebody and base region real gas flow in severe planetary entry by a factored implicit numerical method. II - Equilibrium reactive gas. W. C. Davy, M. J. Green (NASA, Ames Research Center, Moffett Field, Calif.), and C. K. Lombard (Pacific Engineering Design Analysis Corp., Palo Alto, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0282.* 11 p. 11 refs.

The factored-implicit, gas-dynamic algorithm has been adapted to the numerical simulation of equilibrium reactive flows. Changes required in the perfect gas version of the algorithm are developed, and the method of coupling gas-dynamic and chemistry variables is discussed. A flow-field solution that approximates a Jovian entry case was obtained by this method and compared with the same solution obtained by HYVIS, a computer program much used for the study of planetary entry. Comparison of surface pressure distribution and stagnation line shock-layer profiles indicates that the two solutions agree well. (Author)

A81-20755 * # Implicit calculations of transonic flows using monotone methods. P. M. Goorjian (NASA, Ames Research Center, Moffett Field, Calif.) and R. Van Buskirk. *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0331.* 16 p. 9 refs.

Implicit approximate-factorization algorithms have been developed that use monotone methods for the calculation of steady and

unsteady transonic flows governed by the small-disturbance-potential equation. These algorithms use the new Engquist-Osher switch in the type-dependent differencing in place of the standard Murman-Cole switch. The resulting algorithms are more stable; hence, calculations can be done more efficiently. For steady flows, the convergence rate is about 35% faster, and for unsteady flows the allowable time step is about 10 times larger. These improvements are achieved with no increase in computer storage and with only minor modifications in codes that use the Murman-Cole switch. Also an implicit algorithm has been developed for the steady full-potential equation in one-dimension, which uses monotone methods. (Author)

A81-20757 * # A reattaching free shear layer in compressible turbulent flow - A comparison of numerical and experimental results. C. C. Horstman (NASA, Ames Research Center, Experimental Fluid Dynamics Branch, Moffett Field, Calif.), G. S. Settles, D. R. Williams, and S. M. Bogdonoff (Princeton University, Princeton, N.J.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0333.* 11 p. 16 refs.

An investigation of a two-dimensional, free turbulent shear layer reattaching on an inclined surface at Mach 2.92 and at a high Reynolds number is described. The test geometry is specifically designed to isolate the reattachment process of a high-speed separated flow. A numerical solution of the time-dependent, Reynolds-averaged, Navier-Stokes equations for the entire flow field, employing a two-equation eddy viscosity turbulence model, is presented. Detailed comparisons of prediction and experiment are made in the free shear layer, at reattachment, and in the developing boundary layer downstream. These comparisons include mean surface quantities as well as mean and fluctuating flowfield quantities. Although the overall features of this complex flow field are predicted, there are several deficiencies in the numerical solution, particularly in the region downstream of reattachment. Modifications of the turbulence model to correct these deficiencies are discussed. (Author)

A81-20772 * # Preliminary design study of solar probe heat shields. C. Park (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0352.* 14 p. 16 refs.

The requirements, constraints, design guidelines, and expected performances of heat-shield systems for a solar probe are analyzed. A multiple-stage, asymmetric, right-angle radiation cascade configuration is used as the basis for comparison. Output-to-input radiative flux ratios are first calculated for a system employing gray surfaces. Assuming that the temperature of the inner surface of the payload bus is allowed to reach 400 K, it is shown that four- and five-stage cascade systems employing graphite can approach, respectively, to within about 5.5 and 4 solar radii of the sun. The systems using slip-cast silica and tungsten are then analyzed accounting for the degradation of surface-optical performance caused by the solar wind. It is shown that two- and three-stage silica-tungsten systems can approach, respectively, to within 4 and 3 solar radii of the sun. (Author)

A81-20774 * # Ablation and deceleration of mass-driver launched projectiles for space disposal of nuclear wastes. C. Park (NASA, Ames Research Center, Moffett Field, Calif.) and S. W. Bowen (Beam Engineering Co., Sunnyvale, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0355.* 12 p. 18 refs.

The energy cost of launching a projectile containing nuclear waste is two orders of magnitude lower with a mass driver than with a typical rocket system. A mass driver scheme will be feasible, however, only if ablation and deceleration are within certain

tolerable limits. It is shown that if a hemisphere-cylinder-shaped projectile protected thermally with a graphite nose is launched vertically to attain a velocity of 17 km/sec at an altitude of 40 km, the mass loss from ablation during atmospheric flight will be less than 0.1 ton, provided the radius of the projectile is under 20 cm and the projectile's mass is of the order of 1 ton. The velocity loss from drag will vary from 0.4 to 30 km/sec, depending on the mass and radius of the projectile, the smaller velocity loss corresponding to large mass and small radius. Ablation is always within a tolerable range for schemes using a mass driver launcher to dispose of nuclear wastes outside the solar system. Deceleration can also be held in the tolerable range if the mass and diameter of the projectile are properly chosen. C.R.

A81-20839 * # An experimental and computational investigation of the transport of Reynolds stress in an axisymmetric swirling boundary layer. H. Higuchi (Dynamics Technology, Inc., Torrance, Calif.) and M. W. Rubesin (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0416*. 13 p. 18 refs.

A coordinated experimental and computational investigation of the transport and interaction of the individual Reynolds stresses within a turbulent axisymmetric swirling boundary layer flowing over a stationary cylinder is described. The cylinder is instrumented with new directional surface fence skin-friction gages developed for the experiment. The longitudinal and transverse mean velocity profiles are measured with a miniature directional pressure probe. These data provided a standard on which to compare computed results employing a variety of turbulence models. The turbulence models tested range from a simple mixing length model, through a two-equation model, on to the Reynolds stress equation models. The full Reynolds stress equation models are tested with various sets of modeling coefficients for the pressure rate-of-strain correlation. It is shown that while even the simplest model shows the general features of the data, agreement with the experimental data is enhanced through the use of the more complex models. For a better prediction of the data, however, further model improvement is still required.

(Author)

A81-21173 * Implicit finite-difference simulations of steady and unsteady transonic flows. W. F. Ballhaus (U.S. Army, Aeromechanics Laboratory, Moffett Field, Calif.), T. L. Holst, and J. L. Steger (NASA, Ames Research Center, Moffett Field, Calif.). In: *International Conference on Numerical Methods in Fluid Dynamics*, 6th, Tiflis, Georgian SSR, June 21-24, 1978, Proceedings. (A81-21169 07-02) Berlin, Springer-Verlag, 1979, p. 73-78. 14 refs.

Implicit methods for several fluid dynamic formulations have been developed and applied to steady-state and low-frequency transonic flows. The basic steps involved in the construction of implicit schemes include: selection of linearly stable accurate implicit difference operators, time-linearization of nonlinear terms, and approximate factorization of the implicit operators into easily solved systems of equations. The proposed schemes are found very efficient for the simpler formulations. V.L.

A81-21177 * Numerical simulation of turbulent flows with a three-dimensional vortex-in-cell method. O. Buneman, B. Couet (Stanford University, Stanford, Calif.), and A. Leonard (NASA, Ames Research Center, Moffett Field, Calif.). In: *International Conference on Numerical Methods in Fluid Dynamics*, 6th, Tiflis, Georgian SSR, June 21-24, 1978, Proceedings. (A81-21169 07-02) Berlin, Springer-Verlag, 1979, p. 108-114. 14 refs.

A three-dimensional vortex-in-cell method has been developed for the evaluation of local flow fields due to a family of vortex filaments which employs the principles and architecture of a code

developed for magnetic field evaluation in plasma simulations. The computational effort in the new method, as compared to 'vortex pushing' by direct Biot-Savart interaction, increases directly, rather than quadratically, with the number of vortex elements. The method is well suited for studying large number of vortex filaments or rings and can be used for simulating continuous vorticity. V.L.

A81-21195 * A Lagrangian method for the numerical solution of the Euler equations for transonic flows. G. H. Klopfer (NASA, Ames Research Center, Moffett Field, Calif.). In: *International Conference on Numerical Methods in Fluid Dynamics*, 6th, Tiflis, Georgian SSR, June 21-24, 1978, Proceedings. (A81-21169 07-02) Berlin, Springer-Verlag, 1979, p. 318-324. 11 refs.

A81-21658 * An implicit algorithm for the transonic full-potential equation in conservative form. T. Holst (NASA, Ames Research Center, Moffett Field, Calif.). In: *International Conference on Scientific and Technical Calculation Methods*, 4th, Versailles, France, December 10-14, 1979, Proceedings /Provisional edition/. (A81-21651 07-70) Rocquencourt, Yvelines, France, Institut de Recherche d'Informatique et d'Automatique, 1980. 18 p. 22 refs.

A fast, implicit approximate factorization algorithm for the solution of the conservative full-potential equation for transonic flow in two and three dimensions is presented. Stability in supersonic regions is maintained by the use of an upwind evaluation of the density coefficient along all coordinate directions, providing an effective upwind difference of the streamwise terms for any orientation of the velocity vector and thereby enhancing the reliability of the algorithm. The algorithm is shown to provide rapid convergence for the computation of certain difficult two-dimensional test cases, including cases with fishtail shock patterns, demonstrating the reliability and efficiency of the procedure. Surface pressure coefficient distributions obtained by the present method are also found to be in good agreement with those computed by successive-line overrelaxation and a hybrid direct-solver/successive-line overrelaxation scheme, with significant reductions in CPU time required. A three-dimensional solution for a swept wing mounted between parallel walls is also presented which demonstrates the high convergence rate of the algorithm in three dimensions as well as two. A.L.W.

N81-31106*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMIC MATHEMATICAL MODELING - BASIC CONCEPTS c05

Murray Tobak and Lewis B. Schiff /In AGARD Dyn. Stability Parameters May 1981 31 p refs (For primary document see N81-31105 22-01)

Avail: NTIS HC A17/MF A01

The mathematical modeling of the aerodynamic response of an aircraft to arbitrary maneuvers is reviewed. Bryan's original formulation, linear aerodynamic indicial functions, and superposition are considered. These concepts are extended into the nonlinear regime. The nonlinear generalization yields a form for the aerodynamic response that can be built up from the responses to a limited number of well defined characteristic motions, reproducible in principle either in wind tunnel experiments or flow field computations. A further generalization leads to a form accommodating the discontinuous and double valued behavior characteristics of hysteresis in the steady state aerodynamic response. J.D.H.

N81-31121*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SOME APPLICATIONS OF AERODYNAMIC FORMULATIONS TO PROBLEMS IN AIRCRAFT DYNAMICS c05

Lewis B. Schiff and Murray Tobak *In* AGARD Dyn. Stability Parameters May 1981 15 p refs (For primary document see N81-31105 22-01)

Avail: NTIS HC A17/MF A01 CSCL 01C

Two applications of mathematical modeling to aerodynamic problems are cussed. The first application is an investigation of the capacity of a nonlinear aerodynamic mathematical model to describe the aerodynamic reactions on an airfoil with a deflecting flap in transonic flow. Flow field computational methods are used to evaluate the nonlinear, unsteady aerodynamic data in terms of characteristic motions called for by the model. Histories of unconstrained motions of the flap are generated from the flap equations of motion, with the aerodynamic reactions specified by the mathematical model. In the second application wing rock is investigated. The most recent model accommodates experimental results wing rock by admitting the existence of aerodynamic hysteresis in the variation of the steady state rolling moment coefficient with roll angle is described. E.A.K.

N81-33858* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A COMPARATIVE STUDY OF NONREFLECTING FAR-FIELD BOUNDARY CONDITION PROCEDURES FOR UNSTEADY TRANSONIC FLOW COMPUTATION

Dochan Kwak *In its* Numerical Boundary Condition Procedures Oct. 1981 p 21-44 refs (For primary document see N81-33856 24-64)

Avail: NTIS HC A17/MF A01 CSCL 12A

Various nonreflecting far-field boundary condition procedures are compared by implementing them in the computer code LTRAN2. This code solves the implicit finite-difference representation of the small-disturbance equations for transonic flows about airfoils. The first- and second-approximate nonreflecting conditions, as proposed by Engquist and Majda, are compared with the condition derived from the full-characteristic equation. The far-field boundary conditions and the description of the algorithm for implementing these conditions in LTRAN2 are discussed. Various cases are computed and compared with results from the older, more conventional procedures. One concludes that the full-characteristic equation produces the most effective results, thus allowing the far-field boundary to be located closer to the airfoil; this decreases the computer time required to obtain the solution because fewer mesh points are required. T.M.

N81-33865* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CHARACTERISTIC BOUNDARY CONDITIONS FOR THE EULER EQUATIONS

T. H. Pulliam *In its* Numerical Boundary Condition Procedures Oct. 1981 p 165-181 refs (For primary document see N81-33856 24-64)

Avail: NTIS HC A17/MF A01 CSCL 12A

The boundary conditions are demonstrated for the quasi-one-dimensional Euler equations with the extension to two and three dimensions being straightforward. In this application an implicit finite-difference scheme is employed with the boundary conditions being applied implicitly. The boundary application uses both characteristic extrapolations and evaluations which distinguishes it from other theories. Flow fields with shocks are calculated with inflow-outflow conditions of supersonic-subsonic and subsonic-subsonic flow. T.M.

N81-33870* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STABILITY ANALYSIS OF NUMERICAL BOUNDARY CONDITIONS AND IMPLICIT DIFFERENCE APPROXIMATIONS FOR HYPERBOLIC EQUATIONS

R. M. Beam, R. F. Warming, and H. C. Yee *In its* Numerical Boundary Condition Procedures Oct. 1981 p 257-282 refs Also presented at the SIAM Natl. Meeting, Troy, N.Y., 8-10 Jun. 1981 (For primary document see N81-33856 24-64)

Avail: NTIS HC A17/MF A01 CSCL 12A

Implicit, noniterative, finite difference schemes were recently developed by several authors for multidimensional systems of nonlinear hyperbolic partial differential equations. When applied to linear model equations with periodic boundary conditions those schemes are unconditionally stable (A-stable). As applied in practice the algorithms often face a severe time step restriction. A major source of the difficulty is the treatment of the numerical boundary conditions. One conjecture was that unconditional stability requires implicit numerical boundary conditions. An apparent counter example was the space time extrapolation considered by Gustafsson, Kreiss, and Sundstrom. Spatial (implicit) and space time (explicit) extrapolation using normal mode analysis for a finite and infinite number of spatial mesh intervals are examined. The results indicate that for unconditional stability with a finite number of spatial mesh intervals, the numerical boundary conditions must be implicit. Author

N81-33875* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

IMPLICIT BOUNDARY CONDITIONS FOR THE SOLUTION OF THE PARABOLIZED NAVIER-STOKES EQUATIONS FOR SUPERSONIC FLOWS

M. Barnett, R. T. Davis, and J. V. Rakich *In its* Numerical Boundary Condition Procedures Oct. 1981 p 333-351 refs Prepared in cooperation with Cincinnati Univ. (For primary document see N81-33856 24-64)

(Contracts NCA2-OR130-901; NCA2-OR130-101)

Avail: NTIS HC A17/MF A01 CSCL 12A

A fully implicit set of boundary conditions is developed for the solution of the parabolized Navier-Stokes equations for supersonic flow in two dimensions. Shock fitting is employed at the shock and the body has no-slip and specified temperature conditions. A specified heat transfer condition at the wall can be handled in a similar manner. In addition, the shock location is advanced in space in a fully implicit manner by utilizing the Rankine-Hugoniot conditions along with global conservation of mass. Author

A81-37135 * Fatigue behavior of graphite-epoxy laminates

at elevated temperatures. A. Rotem and H. G. Nelson (NASA, Ames Research Center, Materials Science and Applications Office, Moffett Field, Calif.). In: Fatigue of fibrous composite materials; Proceedings of the Symposium, San Francisco, Calif., May 22, 23, 1979. (A81-37126-16-24) Philadelphia, Pa., American Society for Testing and Materials, 1981, p. 152-173. 7 refs.

An examination and analysis is presented of the elevated temperature fatigue behavior of multidirectional graphite-epoxy laminates in terms of single lamina behavior. The laminate strength is predicted by considering the cyclic stress field in each lamina, the interlaminar stresses, and the experimentally determined temperature-effect 'shifting factors'. The initial failure of a lamina in a laminate is examined first in terms of stress redistribution, and then in terms of total failure and final laminate fracture; these analytical results are then compared with the actual fatigue behavior of T300/5208 graphite-epoxy composite laminates. In view of the agreement obtained, it is concluded that the temperature 'shifting factors' introduced here enable one to predict long-term behavior at a given temperature from short-time testing at elevated temperatures. O.C.

A81-37527 * # Some prospects for the future of computational fluid dynamics. H. Lomax (NASA, Ames Research Center, Moffett Field, Calif.). In: Computational Fluid Dynamics Conference, 5th, Palo Alto, Calif., June 22, 23, 1981, Collection of Technical Papers.

(A81-37526 16-34) New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 3-15. 28 refs. (AIAA 81-0994)

For the oncoming decade it is anticipated that new generations of high-capacity and high-speed computers will appear and that some

of them will be dedicated to fluid dynamics applications. An attempt is made here to examine the potential for a new generation of numerical techniques that will accompany the computer advances. Possibilities for improvement in solution techniques, grid adaptations, turbulence approximations, language constructions, and general code robustness are considered. (Author)

A81-37533 * # Numerical simulation of steady transonic flow about airfoils. S. C. Lee (Missouri-Rolla, University, Rolla, Mo.) and W. R. Van Dalsem (NASA, Ames Research Center, Applied Computational Aerodynamics Branch, Moffett Field, Calif.). In: Computational Fluid Dynamics Conference, 5th, Palo Alto, Calif., June 22, 23, 1981, Collection of Technical Papers. (A81-37526 16-34) New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 69-76. 30 refs. (AIAA 81-1002)

A computer code has been developed that couples a fast transonic full-potential AF2 solver with both an efficient integral boundary-layer method and a viscous wedge approximation of the shock/boundary-layer interaction. The efficiency of the coupled analysis methods and the method of coupling has resulted in a uniquely efficient analysis tool. The airfoil geometry is modified by the displacement thickness before the shock and the displacement thickness plus the viscous wedge thickness after the shock by considering the viscous effects as an equivalent transpiration boundary condition. The flow about conventional and supercritical airfoils under moderately strong shock situations has been calculated. Comparisons with experimental data indicate that this viscous correction method has improved the accuracy of the full-potential analysis. Furthermore, the computer time required to obtain a converged solution has been reduced. (Author)

A81-37538 * # Stable boundary approximations for a class of implicit schemes for the one-dimensional inviscid equations of gas dynamics. H. C. Yee, R. M. Beam, and R. F. Warming (NASA, Ames Research Center, Moffett Field, Calif.). In: Computational Fluid Dynamics Conference, 5th, Palo Alto, Calif., June 22, 23, 1981, Collection of Technical Papers. (A81-37526 16-34) New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 125-135. 37 refs. (AIAA 81-1009)

The applicability to practical calculations of recent theoretical developments in the stability analysis of difference approximations for initial-boundary-value problems of the hyperbolic type. For the numerical experiments, select the one-dimensional inviscid gas-dynamic equations in conservation-law form is selected. A class of implicit schemes based on linear multistep methods for ordinary differential equations is chosen and the use of space or space-time extrapolations as implicit or explicit boundary schemes is emphasized. Some numerical examples with various inflow-outflow conditions highlight the commonly discussed issues: explicit versus implicit boundary schemes, unconditionally stable schemes, and underspecification or overspecification of boundary conditions. (Author)

A81-37539 * # Transonic airfoil calculations using solution-adaptive grids. T. L. Holst (NASA, Ames Research Center, Applied Computational Aerodynamics Branch, Moffett Field, Calif.) and D. Brown. In: Computational Fluid Dynamics Conference, 5th, Palo Alto, Calif., June 22, 23, 1981, Collection of Technical Papers. (A81-37526 16-34) New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 136-148. 17 refs. (AIAA 81-1010)

A new algorithm for generating solution-adaptive grids (SAG) about airfoil configurations embedded in transonic flow is presented. The present SAG approach uses only the airfoil surface solution to recluster grid points on the airfoil surface, i.e., the reclustering problem is one dimension smaller than the flow-field calculation problem. Special controls automatically built into the elliptic grid generation procedure are then used to obtain grids with suitable

interior behavior. This concept of redistributing grid points greatly simplifies the idea of solution-adaptive grids. Numerical results indicate significant improvements in accuracy for SAG grids relative to standard grids using the same number of points. (Author)

A81-38097 * # Numerical simulation of transonic flows in diffusers. M.-S. Liou, T. J. Coakley, and M. Y. Bergmann (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1240.* 8 p. 14 refs. Research supported by the McDonnell Douglas Independent Research and Development Program and NASA.

Numerical simulations were made of two-dimensional transonic flows in diffusers, including flow separation induced by a shock or adverse pressure gradient. The mass-averaged, time-dependent, compressible Navier-Stokes equations, simplified by the thin-layer approximation, were solved using MacCormack's hybrid method. The eddy-viscosity formulation was described by the Wilcox-Rubesin's two-equation, k - ω model. Detailed comparison of the computed results with measurements showed good agreement in all cases, including one with massive separation induced by a strong shock. The computation correctly predicted the details of a distinct lambda shock pattern, closely duplicating the configuration observed experimentally in spark-schlieren photographs. (Author)

A81-38100 * # Computation of separated flows by a vortex-tracing algorithm. P. R. Spalart (NASA, Ames Research Center, Moffett Field; Stanford University, Stanford, CA) and A. Leonard (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1246.* 14 p. 22 refs.

Numerical solutions for two-dimensional, time-dependent, separated flows around bodies are obtained, using a new version of the vortex method. This method provides an efficient representation of flows involving large regions of separation. The modifications incorporated in the new version, which improve its accuracy, versatility, and computing speed, are described. The computer cost is only of the order of the $3/2$ power on N , instead of N -squared, for each step with N vortices. Arbitrary shapes can be treated; a conformal mapping is not required. Special attention is paid to the viscous character of the solution and to the accurate computation of the pressure distribution at the body surface. The vortex solution for the outer flow is coupled to an inner solution for the attached part of the boundary layer. Numerical results are presented for several bluff bodies exhibiting dependence on Reynolds number, for stationary airfoils under steady or transient conditions and for oscillating airfoils, including dynamic stalls. These results are compared with other available results, analytical or experimental, and demonstrate the enhanced reliability and accuracy of the improved method. (Author)

A81-39013 * # Numerical method for gas dynamics combining characteristic and conservation concepts. T. J. Coakley (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1257.* 17 p. 20 refs.

An efficient implicit numerical method that solves the compressible Navier-Stokes equations in arbitrary curvilinear coordinates by the finite-volume technique is presented. An intrinsically dissipative difference scheme and a fully implicit treatment of boundary conditions, based on characteristic and conservation concepts, are used to improve stability and accuracy. Efficiency is achieved by using a diagonal form of the implicit algorithm and spatially varying time-steps. Comparisons of various schemes and methods are presented for one- and two-dimensional flows, including transonic

separated flow past a thick circular-arc airfoil in a channel. The new method is equal to or better than a version of MacCormack's hybrid method in accuracy and it converges to a steady state up to an order of magnitude faster. (Author)

A81-39068 * # Graphitic heat shields for solar probe missions. J. H. Lundell (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1056.* 15 p. 13 refs.

The feasibility of using a graphitic heat-shield system on a solar probe going to within 4 solar radii of the center of the sun is investigated. An analysis of graphite vaporization, with commonly used vaporization coefficients, indicates that the maximum mass-loss rate from a conical shield as large as 4 m in diameter can be kept low enough to avoid interference with measurements of the solar environment. In addition to the mass-loss problem, the problem of protecting the payload from the high-temperature (up to 2300 K) primary shield must be solved. An analysis of radiation exchange between concentric disks provides a technique for designing the intermediate shielding. The technique is applied to the design of a system for the Starprobe spacecraft, and it is found that a system with 10 shields and a payload surface temperature of 600 K will have a payload diameter of 2.45 m. Since this is 61% of the 4-m diameter of the primary shield, it is concluded that a graphitic heat-shield system is feasible for the Starprobe mission. (Author)

A81-39069 * # Experimental determination of ablation vapor species from carbon phenolic heat-shield materials. K. A. Lincoln (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1057.* 7 p. 6 refs.

The relative concentrations of vapors produced from carbon phenolic composites under thermal loadings approximating those expected at peak heating during vehicle entry into the atmospheres of the outer planets have been determined. The technique of vaporizing the surface of bulk samples by laser irradiation while measuring in situ the vapor species by mass spectrometry is described. Results show that vapor composition varies with irradiance level and with depth of heating (or extent of pyrolysis). Attempts are made to compare these experimental results with the theoretical predictions from computer codes. (Author)

A81-39078 * # Survey of the supporting research and technology for the thermal protection of the Galileo Probe. J. T. Howe, W. C. Pitts, and J. H. Lundell (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1068.* 16 p. 59 refs.

The Galileo Probe, which is scheduled to be launched in 1985 and to enter the hydrogen-helium atmosphere of Jupiter up to 1,475 days later, presents thermal protection problems that are far more difficult than those experienced in previous planetary entry missions. The high-entry speed of the Probe will cause forebody heating rates orders of magnitude greater than those encountered in the Apollo and Pioneer Venus missions, severe afterbody heating from base-flow radiation, and thermochemical ablation rates for carbon phenolic that rival the free-stream mass flux. This paper presents a comprehensive survey of the experimental work and computational research that provide technological support for the Probe's heat-shield design effort. The survey includes atmospheric modeling; both approximate and first-principle computations of flow fields and heat-shield material response; base heating; turbulence modelling; new computational techniques; experimental heating and materials studies; code validation efforts; and a set of 'consensus' first-principle flow-field solutions through the entry maneuver, with predictions of the corresponding thermal protection requirements. (Author)

A81-39079 * # An evaluation of computer codes for simulating the Galileo Probe aerothermal entry environment. G. P. Menees (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1069.* 25 p. 24 refs.

The approaches of three computer flow field codes (HYVIS, COLTS, and RASLE), used to determine the Galileo Probe aerothermal environment and its effect on the design of the thermal protection system, are analyzed in order to resolve differences in their predicted results. All three codes account for the hypersonic, massively blown, radiation shock layers, characteristic of Jupiter entry. Significant differences, however, are evident in their solution procedures: the governing conservation equations, the numerical differencing methods, the governing physics (chemical, radiation, diffusion, and turbulence models), and the basic physical data (thermodynamic, transport, chemical, and spectral properties for atomic and molecular species). Solutions are compared for two near peak heating entry conditions for a Galileo Probe baseline configuration, having an initial mass of 242 kg and simulating entry into the Orton nominal atmosphere. The modern numerical methodology of COLTS and RASLE appear to provide an improved capability for coupled flow-field solutions. J.F.

A81-39081 * # The effect of modeled turbulence on a hypersonic shock layer with massive ablation injection. G. P. Menees (NASA, Ames Research Center, Moffett Field, CA) and C. K. Lombard (PEDA Corp., Palo Alto, CA). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1071.* 18 p. 17 refs.

For the first time, candidate turbulence models are analyzed for shock-layer conditions as severe as those of a Jovian entry. The various models investigated are two standard models developed primarily by Cebeci (1970) and Kendall (1972), and two modifications of the standard models developed primarily by Baldwin and Lomax (1978) and by Nicolet (1979). The analysis is conducted within the context of a new, viscous shock-layer flow-field code, to properly isolate differences in performance among the various models. This code retains all terms in the Navier-Stokes equations necessary to describe the unique flow events, and incorporates computational features that greatly facilitate the analysis of such events. The relative superiority of the turbulence models cannot be determined from this study alone; however, insight is provided into the relative severity of the various models. In addition, attention is focused on an important research area for experimental and theoretical investigation to develop realistic turbulence models. (Author)

A81-39082 * # Galileo Probe forebody thermal protection. M. J. Green and W. C. Davy (NASA, Ames Research Center, Entry Technology Branch, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1073.* 16 p. 18 refs.

Material response solutions for the forebody heat shield on the candidate 310-kg Galileo Probe are presented. A charring material ablation analysis predicts thermochemical surface recession, insulation thickness, and total required heat shield mass. Benchmark shock layer solutions provide the imposed entry heating environments on the ablating surface. Heat shield sizing results are given for a nominal entry into modeled nominal and cool-heavy Jovian atmospheres, and for two heat-shield property models. The nominally designed heat shield requires a mass of at least 126 kg and would require an additional 13 kg to survive entry into the less probable cool-heavy atmosphere. The material-property model with a 30% surface reflectance reduces these mass requirements by as much as 16%. (Author)

A81-39132 * # Catalytic surface effects experiment on the Space Shuttle. D. A. Stewart, J. V. Rakich (NASA, Ames Research

Center, Moffett Field, CA), and M. J. Lanfranco (Informatics, Inc., Palo Alto, CA). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 16th, Palo Alto, CA, June 23-25, 1981, Paper 81-1143*. 16 p. 22 refs.

A Space Shuttle experiment planned to measure the surface catalytic efficiency of the baseline high-temperature reusable surface insulation (HRSI) during earth entry is described. A spray-on overcoat, with high catalytic efficiency, will be used as a comparative basis for determining the HRSI surface catalytic efficiency through surface temperature measurement. Catalytic efficiency, as well as aerothermal response of the overcoat, was evaluated, using various models made of HRSI material in arc-plasma flow environments. Agreement is obtained between the measured and computed heating rise of the coated surfaces. Computed predictions for the flight case are presented. (Author)

PATENTS

N81-13999* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STRUCTURAL WOOD PANELS WITH IMPROVED FIRE RESISTANCE Patent

Paul M. Sawko, Inventor (to NASA) Issued 24 Jun. 1980 4 p
Filed 28 Jul. 1978 Supersedes N78-28178 (16-19, p 2498)
(NASA-Case-ARC-11174-1; US-Patent-4,209,561;
US-Patent-Appl-SN-929086; US-Patent-Class-428-114;
US-Patent-Class-260-17.2; US-Patent-Class-428-528;
US-Patent-Class-428-541; US-Patent-Class-428-921) Avail: US
Patent and Trademark Office CSCL 11L

Structural wood paneling or other molded wood compositions consisting of finely divided wood chips, flour, or strands are bound together and hot pressed with a modified novolac resin which is the cured product of a prepolymer made from an alkyl ether or halide with a phenol and a hardening agent such as hexamethylene tetramine. The fire resistance of these articles is further improved by incorporating in the binder certain inorganic fillers, especially a mixture of ammonium oxalate and ammonium phosphate.

Official Gazette of the U.S. Patent and Trademark Office

OFFICE OF THE DIRECTOR OF LIFE SCIENCES

NASA TECHNICAL MEMORANDA

N81-32831*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT K304: STUDIES OF SPECIFIC HEPATIC ENZYMES AND LIVER CONSTITUENTS INVOLVED IN THE CONVERSION OF CARBOHYDRATES TO LIPIDS IN RATS EXPOSED TO PROLONGED SPACE FLIGHT Final Report S. Abraham (Children's Hospital Medical Center, Oakland, Calif.), H. P. Klein, C. Y. Lin (Children's Hospital Medical Center, Oakland, Calif.), C. Volkmann, R. A. Tigranyan (Inst. of Medical and Biological Problems, Moscow), and E. G. Vetrova (Inst. of Medical and Biological Problems, Moscow) *In its US Rat Expts. Flown on the Soviet Satellite Cosmos 1129 Aug. 1981 p 35-100 refs* (For primary document see N81-32830 23-51)
Avail: NTIS HC A19/MF A01 CSCL 06C

The effects of space flight on the activities of 26 enzymes concerned with carbohydrate and lipid metabolism in hepatic tissue taken from male Wistar rats are investigated. These activities were measured in the various hepatic cell compartments, i.e., cytosol, mitochondria and microsomes. In addition, the levels of glycogen, total lipids, phospholipids, triglycerides, cholesterol, cholesterol esters, and the fatty acid composition of the rat livers were also examined and quantified. A similar group of ground-based rats treated in an identical manner served as controls. Both flight and synchronous control rats were sacrificed at three time intervals: R+0, 7-11 hours after recovery; R+6, after 6 days; R+6(S), after 6 days (having undergone 2-5 hour periods of fixed stress in a 'backward' position on days 0, 3, 4, 5 and 6) and R+29, after 29 days post-flight. Although most of the enzyme activities and the amounts of liver constituents studied were unaffected by the period of weightlessness, some significant differences were observed. J.D.H.

NASA CONTRACTOR REPORTS

N81-27778*# Utah Univ., Salt Lake City. Dept. of Psychology.

TO DEVELOP BEHAVIORAL TESTS OF VESTIBULAR FUNCTIONING IN THE WISTAR RAT Final Report, Dec. 1978 - Nov. 1980

Harold C. Nielson Nov. 1980 26 p refs

(Grant NSG-2350)

(NASA-CR-164537) Avail: NTIS HC A03/MF A01 CSCL 06C

Two tests of vestibular functioning in the rat were developed. The first test was the water maze. In the water maze the rat does not have the normal proprioceptive feedback from its limbs to help it maintain its orientation, and must rely primarily on the sensory input from its visual and vestibular systems. By altering lighting conditions and visual cues the vestibular functioning without visual cues was assessed. Whether there was visual compensation for some vestibular dysfunction was determined. The second test measured vestibular functioning of the rat's behavior on a parallel swing. In this test the rat's postural adjustments while swinging on the swing with the otoliths

being stimulated were assessed. Less success was achieved in developing the parallel swing as a test of vestibular functioning than with the water maze. The major problem was incorrect initial assumptions of what the rat's probable behavior on the parallel swing would be. S.F.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-15483 * Subunit specificity of the two acetyl-CoA synthetases of yeast as revealed by an immunological approach. T. Satyanarayana (NASA, Ames Research Center, Extraterrestrial Research Div., Moffett Field, Calif.), C. H. Chervenka (Beckman Instruments, Inc., Palo Alto, Calif.), and H. P. Klein. *Biochimica et Biophysica Acta*, vol. 614, 1980, p. 601-606. 9 refs.

CONFERENCE AND MEETING PAPERS

A81-40381 * The effects of space flight on some rat liver enzymes regulating carbohydrate and lipid metabolism. S. Abraham, C. Y. Lin (Children's Hospital Medical Center, Bruce Lyon Memorial Research Laboratory, Oakland, CA), H. P. Klein, and C. Volkmann (NASA, Ames Research Center, Moffett Field, CA). (*COSPAR, Topical Meeting on Life Sciences and Space Research XIX, Budapest, Hungary, June 2-14, 1980.*) *Advances in Space Research*, vol. 1, no. 14, 1981, p. 199-217. 42 refs. Contract No. NAS2-9523.

The effects of space flight conditions on the activities of certain enzymes regulating carbohydrate and lipid metabolism in rat liver are investigated in an attempt to account for the losses in body weight observed during space flight despite preflight caloric consumption. Liver samples were analyzed for the activities of 32 cytosolic and microsomal enzymes as well as hepatic glycogen and individual fatty acid levels for ground control rats and rats flown on board the Cosmos 936 biosatellite under normal space flight conditions and in centrifuges which were sacrificed upon recovery or 25 days after recovery. Significant decreases in the activities of glycogen phosphorylase, alpha-glycerol phosphate acyl transferase, diglyceride acyl transferase, aconitase and 6-phosphogluconate dehydrogenase and an increase in palmitoyl CoA desaturase are found in the flight stationary relative to the flight centrifuged rats upon recovery, with all enzymes showing alterations returning to normal values 25 days postflight. The flight stationary group is also observed to be characterized by more than twice the amount of liver glycogen of the flight centrifuged group as well as a significant increase in the ratio of palmitic to palmitoleic acid. Results thus indicate metabolic changes which may be involved in the mechanism of weight loss during weightlessness, and demonstrate the equivalence of centrifugation during space flight to terrestrial gravity. A.L.W.

BIOMEDICAL RESEARCH DIVISION

NASA TECHNICAL MEMORANDA

N81-14606*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NALOXONE INHIBITS AND MORPHINE POTENTIATES THE ADRENAL STEROIDOGENIC RESPONSE TO ACTH
John P. Heybach and Joan Vernikos Dec. 1980 17 p refs
(NASA-TM-81253; A-8416) Avail: NTIS HC A02/MF A01 CSCI 06P

The adrenal actions were stereospecific since neither the positive stereoisomer of morphine, nor that of naloxone, had any effect on the adrenal response to exogenous adrenocorticotrophic hormone (ACTH). The administration of human beta endorphin to phytopsectomized rats had no effect on the adrenal corticosterone concentration nor did it alter the response of the adrenal gland to ACTH. These results indicate that morphine can potentiate the action of ACTH on the adrenal by a direct, stereospecific, dose dependent mechanism that is prevented by naloxone pretreatment and which may involve competition for ACTH receptors on the corticosterone secreting cells of the adrenal cortex. Author

N81-17692*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

USE OF AN ELECTRICAL RESISTANCE HYGROMETER TO MEASURE HUMAN SWEAT RATES
Toshiyuki Suga Oct. 1980 30 p refs
(NASA-TM-81223; A-8306) Avail: NTIS HC A03/MF A01 CSCI 06P

The application of the resistance hygrometer as a tool to measure the localized sweat rate from the human body in both the active and passive sweat regions was studied. It was found that the physiological function of the skin membrane and fluid carrier transport phenomena from the outer skin have an indistinguishable effect on the observed findings from the instrument. The problems associated with the resistance hygrometer technique are identified and the usage of the instrument in the physiological experimentation from the engineering standpoint is evaluated. Author

N81-24720*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECTS OF CIRCADIAN RHYTHM PHASE ALTERATION ON PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES: IMPLICATIONS TO PILOT PERFORMANCE (INCLUDING A PARTIALLY ANNOTATED BIBLIOGRAPHY)

Daniel C. Holley, Charles M. Winger, Charles W. DeRoshia, Michele P. Heinold, Dale M. Edgar, Norman E. Kinney, Susan E. Langston, Carol L. Markley, and Jill A. Anthony Mar. 1981 537 p Prepared in cooperation with San Jose State Univ., Calif.
(NASA-TM-81277; A-8515) Avail: NTIS HC A23/MF A01 CSCI 06P

The effects of environmental synchronizers upon circadian rhythmic stability in man and the deleterious alterations in performance and which result from changes in this stability are points of interest in a review of selected literature published between 1972 and 1980. A total of 2,084 references relevant to pilot performance and circadian phase alteration are cited and arranged in the following categories: (1) human performance, with focus on the effects of sleep loss or disturbance and fatigue; (2) phase shift in which ground based light/dark alteration and transmeridian flight studies are discussed; (3) shiftwork; (4) internal desynchronization which includes the effect of environmental factors on rhythmic stability, and of rhythm disturbances on sleep and psychopathology; (5) chronotherapy, the application of methods to ameliorate desynchronization symptomatology; and (6) biorythm theory, in which the birthdate

based biorythm method for predicting aircraft accident susceptibility is critically analyzed. Annotations are provided for most citations. A.R.H.

N81-24721*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A 14-DAY GROUND-BASED HYPOKINESIA STUDY IN NONHUMAN PRIMATES: A COMPILATION OF RESULTS
L. Kazarian (Wright-Patterson AFB, Ohio), C. Cann (California Univ.), M. Parfitt (Henry Ford Hospital), D. Simmons (Washington Univ.), and E. Morey-Holton Apr. 1981 62 p refs
(NASA-TM-81268; A-8488) Avail: NTIS HC A04/MF A01 CSCI 06S

A 14 day ground based hypokinesia study with rhesus monkeys was conducted to determine if a spaceflight of similar duration might affect bone remodeling and calcium homeostasis. The monkeys were placed in total body casts and sacrificed either immediately upon decasting or 14 days after decasting. Changes in vertebral strength were noted and further deterioration of bone strength continued during the recovery phase. Resorption in the vertebrae increased dramatically while formation decreased. Cortical bone formation was impaired in the long bones. The immobilized animals showed a progressive decrease in total serum calcium which rebounded upon remobilization. Most mandibular parameters remained unchanged during casting except for retardation of osteon birth or maturation rate and density distribution of matrix and mineral moieties. Author

N81-25655*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

US PLANT AND RADIATION DOSIMETRY EXPERIMENTS FLOWN ON THE SOVIET SATELLITE COSMOS 1129 Final Report

Milton R. Heinrich, ed. and Kenneth A. Souza, ed. May 1981 194 p refs
(NASA-TM-81288; A-8572) Avail: NTIS HC A09/MF A01 CSCI 06C

Experiments included: 30 young male Wistar SPF rats used for wide range physiological studies; experiments with plants, fungi, insects, and mammalian tissue cultures; radiation physics experiments; a heat convection study; a rat embryology experiment in which an attempt was made to breed 2 male and 5 female rats during the flight; and fertile quail eggs used to determine the effects of spaceflight on avian embryogenesis. Specimens for US experiments were initially prepared at the recovery site or in Moscow and transferred to US laboratories for complete analyses. An overview of the mission focusing on preflight, on orbit, and postflight activities pertinent to the fourteen US experiments aboard Cosmos 1129 is presented. T.M.

N81-32830*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

US RAT EXPERIMENTS FLOWN ON THE SOVIET SATELLITE COSMOS 1129 Final Report

Milton R. Heinrich, ed. and Kenneth A. Souza, ed. Aug. 1981 441 p refs
(NASA-TM-81289; A-8572) Avail: NTIS HC A19/MF A01 CSCI 06C

The physiological effects of an 18.5 day space flight on young male Wistar rats, on rat embryology, and on fertile quail eggs are described. For individual titles, see N81-32831 through N81-32845.

N81-32832*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT K305: QUANTITATIVE ANALYSIS OF SELECTED BONE PARAMETERS Final Report

Thomas J. Wrongski, Emily Morey-Holton, Christopher E. Cann (California Univ., San Francisco), Claude D. Arnaud (California Univ., San Francisco), David J. Baylink (American Lake Veterans Administration Medical Center, Tacoma, Wash.), Russell T. Turner (American Lake Veterans Administration Medical Center, Tacoma, Wash.), and Webster S. S. Jee (Utah Univ., Salt Lake City) *In its US Rat Expts. Flown on the Soviet Satellite Cosmos 1129 Aug. 1981 p 101-125 refs (For primary document see N81-32830 23-51)*

Avail: NTIS HC A19/MF A01 CSCL 06C

The skeletal alterations induced by space flight were determined to be a reduced rate of periosteal bone formation in tibial and humeral diaphyses, a decreased trabecular bone volume, and an increased fat content of the bone marrow in the proximal tibial metaphysis. An increased incidence of arrest lines in flight animals suggested that periosteal bone formation may have ceased during space flight. Endosteal bone resorption was not affected markedly.

Author

N81-32833*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT K305: QUANTITATIVE ANALYSIS OF SELECTED BONE PARAMETERS. SUPPLEMENT 1: EFFECTS OF WEIGHTLESSNESS ON OSTEOBLAST DIFFERENTIATION IN RAT MOLAR PERIODONTIUM Final Report

W. Eugene Roberts (Univ. of the Pacific, San Francisco), Peter G. Mozsary (Univ. of The Pacific, San Francisco), and Emily Morey-Holton *In its US Rat Expts. Flown on the Soviet Satellite Cosmos 1129 Aug. 1981 p 127-148 refs (For primary document see N81-32830 23-51)*

Avail: NTIS HC A19/MF A01 CSCL 06C

The morphometric analysis of periodontal ligament (PDL), the osteogenic interface between tooth and bone, is described. Immediately post-flight, PDL width and total cell number were decreased. Frequency distributions of nuclear volume revealed that presumptive preosteoblasts were particularly depressed. Depleted numbers of preosteoblasts may be an important factor in the mechanism of inhibited bone formation during weightlessness.

J.D.H.

N81-32842*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT K-314: FETAL AND NEONATAL RAT BONE AND JOINT DEVELOPMENT FOLLOWING IN UTERO SPACEFLIGHT Final Report

E. E. Sabelman (California Univ., San Francisco), E. M. Holton, and C. D. Arnaud (California Univ., San Francisco) *In its US Rat Expts. Flown in the Soviet Satellite Cosmos 1129 Aug. 1981 p 363-404 refs (For primary document see N81-32830 23-51)*

Avail: NTIS HC A19/MF A01 CSCL 06C

Infant rat limb specimens from Soviet and U.S. ground-based studies were examined by radiography, macrophotography, histologic sectioning and staining and scanning electron microscopy. A comparison was conducted between vivarium and flight-type diets suggesting that nutritional abesity may adversely affect pregnancy. Data were obtained on maturation of ossification centers, orientation of collagen fibers in bone, tendon and ligaments, joint surface texture and spatial relationships of bones of the hind limb. Computer reconstructions of the knee and hip show promise as a means of investigating the etiology of congenital hip dislocation.

Author

N81-32843*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT K-315: STUDIES OF THE NASAL MUCOSA Final Report

Lisbeth M. Kraft *In its US Rat Expts. Flown in the Soviet*

Satellite Cosmos 1129 Aug. 1981 p 405-414 refs (For primary document see N81-32830 23-51)

Avail: NTIS HC A19/MF A01 CSCL 06C

The posterior regions of the olfactory nasal mucosa of rat: flown on Cosmos 1129 failed to reveal histopathological changes. These results are at variance with those of the Apollo 12 Biocore experiment in which severe necrotic olfactory mucosal lesions were seen in flight animals only. In the anterior aspect of the nasal cavity of the Cosmos 1129 rats, however, focal lesions of moderate severity and variable extent were seen. These were consistent in character with that of a mild virus infection, which, it is postulated, was self-limiting. The infection was present in all groups of animals: flight, synchronous and vivarium control.

Author

N81-32845*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENT K-317: BONE RESORPTION IN RATS DURING SPACEFLIGHT Final Report

Christopher E. Cann (California Univ., San Francisco) and Richard R. Adachi *In its US Rats Expts. Flown in the Soviet Satellite Cosmos 1129 Aug. 1981 p 427-438 refs (For primary document see N81-32830 23-51)*

Avail: NTIS HC A19/MF A01 CSCL 06C

Direct measurement of bone resorption in flight and synchronous control rats is described. Continuous tracer administration techniques were used, with replacement of dietary calcium with isotopically enriched Ca40 and measurement by neutron activation analysis of the Ca48 released by the skeleton. There is no large change in bone resorption in rats. Based on the time course of changes, the measured 20-25% decrease in resorption is probably secondary to a decrease in total body calcium turnover. The excretion of sodium, potassium and zinc all increase during flight, sodium and potassium to a level 4-5 times control values.

J.D.H.

NASA CONTRACTOR REPORTS

N81-15663*# San Francisco State Univ., Calif. Dept. of Biological Sciences.

EFFECTS OF CENTRIFUGATION ON GONADAL AND ADRENOCORTICAL STEROIDS IN RATS Final Report, 1 Nov. 1979 - 31 Oct. 1980

R. Kakhana and J. C. Butte 31 Oct. 1980 16 p refs (Contract NCC2-25)

(NASA-CR-163858) Avail: NTIS HC A02/MF A01 CSCL 06C

Many endocrine systems are sensitive to external changes in the environment. Both the pituitary adrenal and pituitary gonadal systems are affected by stress including centrifugation stress. The effect of centrifugation on the pituitary gonadal and pituitary adrenocortical systems was examined by measuring the gonadal and adrenal steroids in the plasma and brain following different duration and intensity of centrifugation stress in rats. Two studies were completed and the results are presented. The second study was carried out to describe the developmental changes of brain, plasma and testicular testosterone and dihydrotestosterone in Sprague Dawley rats so that the effect of centrifugation stress on the pituitary gonadal system could be better evaluated in future studies.

T.M.

N81-25665*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

HABITUATION TO NOVEL VISUAL VESTIBULAR ENVIRONMENTS WITH SPECIAL REFERENCE TO SPACE FLIGHT Final Report, 1974 - 1980

Laurence R. Young, Robert V. Kenyon, and Charles M. Oman Jun. 1981 20 p refs

(Grant NsG-2032) (NASA-CR-164437) Avail: NTIS HC A02/MF A01 CSCL 06P

The etiology of space motion sickness and the underlying physiological mechanisms associated with spatial orientation in a space environment were investigated. Human psychophysical experiments were used as the basis for the research concerning the interaction of visual and vestibular cues in the development of motion sickness. Particular emphasis is placed on the conflict theory in terms of explaining these interactions. Research on the plasticity of the vestibulo-ocular reflex is discussed. T.M.

**N81-25686*# Wayne State Univ., Detroit, Mich.
DETERMINATION OF IN VIVO MECHANICAL PROPERTIES
OF LONG BONES FROM THEIR IMPEDANCE RESPONSE
CURVES Final Report**

Stephen G. Borders [1981] 262 p refs

(Grant NsG-2008)

(NASA-CR-164441) Avail: NTIS HC A12/MF A01 CSCI
06P

A mathematical model consisting of a uniform, linear, visco-elastic, Euler-Bernoulli beam to represent the ulna or tibia of the vibrating forearm or leg system is developed. The skin and tissue compressed between the probe and bone is represented by a spring in series with the beam. The remaining skin and tissue surrounding the bone is represented by a visco-elastic foundation with mass. An extensive parametric study is carried out to determine the effect of each parameter of the mathematical model on its impedance response. A system identification algorithm is developed and programmed on a digital computer to determine the parametric values of the model which best simulate the data obtained from an impedance test. E.D.K.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-13923 * Body acceleration distribution and O₂ uptake in humans during running and jumping. A. Bhattacharya, E. P. McCutcheon, E. Shvartz, and J. E. Greenleaf (NASA, Ames Research Center, Biomedical Research Div., Moffett Field, Calif.; Kentucky, University, Lexington, Ky.). *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology*, vol. 49, Nov. 1980, p. 881-887. 26 refs.

The distribution of body acceleration and associated oxygen uptake and heart rate responses are investigated in treadmill running and trampoline jumping. Accelerations in the +Gz direction were measured at the lateral ankle, lumbosacral region and forehead of eight young men during level treadmill walking and running at four speeds and trampoline jumping at four heights, together with corresponding oxygen uptake and heart rate. With increasing treadmill speed, peak acceleration at the ankle is found always to exceed that at the back and forehead, and acceleration profiles with higher frequency components than those observed during jumping are observed. Acceleration levels are found to be more uniformly distributed with increasing height in jumping, although comparable oxygen uptake and heart rates are obtained. Results indicate that the magnitude of the biomechanical stimuli is greater in trampoline jumping than in running, which finding could be of use in the design of procedures to avert deconditioning in persons exposed to weightlessness. A.L.W.

A81-15496 * Subcortical afferent connections of the amygdala in the monkey. W. R. Mehler (NASA, Ames Research Center, Biomedical Research Div., Moffett Field, California, University, San Francisco, Calif.). *Journal of Comparative Neurology*, vol. 190, 1980, p. 733-762. 117 refs. NASA Task 199-05-02-07.

The cells of origin of the afferent connections of the amygdala in the rhesus and squirrel monkeys are determined according to the

retrograde axonal transport of the enzyme horseradish peroxidase injected into various quadrants of the amygdala. Analysis of the distribution of enzyme-labeled cells reveals afferent amygdalar connections with the ipsilateral halves of the midline nucleus paraventricularis thalami and both the parvo- and magnocellular parts of the nucleus subparafascicularis in the dorsal thalamus, all the subdivisions of the midline nucleus centralis complex, the nucleus reuniens ventralis and the nucleus interventralis. The largest populations of enzyme-labeled cells in the hypothalamus are found to lie in the middle and posterior parts of the ipsilateral, lateral hypothalamus and the ventromedial hypothalamic nucleus, with scattered cells in the supramammillary and dorsomedial nuclei and the posterior hypothalamic area, Tsai's ventral tegmental area, the rostral and caudal subdivisions of the nucleus linearis in the midbrain and the dorsal raphe nucleus. The most conspicuous subdienecephalic source of amygdalar afferent connections is observed to be the pars lateralis of the nucleus parabrachialis in the dorsolateral pontine tegmentum, with a few labeled cells differentiated from pigmented cells in the locus coeruleus. A.L.W.

A81-21473 * Plasma volume, osmolality, vasopressin, and renin activity during graded exercise in man. V. A. Convertino, L. C. Keil, E. M. Bernauer, and J. E. Greenleaf (NASA, Ames Research Center, Biomedical Research Div., Moffett Field, Calif.). *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology*, vol. 50, Jan. 1981, p. 123-128. 33 refs. Grant No. NCA2-OR-180-703.

The influence of work intensity on plasma volume, osmolality, vasopressin and renin activity and the interrelationships between these responses are investigated. Plasma volume, renin activity and osmotic, sodium and arginine vasopressin concentrations were measured in venous blood samples taken from 15 healthy male subjects before and after six minutes of bicycle ergometer exercise at 100, 175 and 225 W. Plasma volume is found to decrease significantly with increasing work intensity, while increases in Na⁺ concentration, osmolality and vasopressin are only observed to be significant when the work intensity exceeds 40% maximal aerobic capacity and plasma renin activity increased linearly at all work levels. In addition, significant correlations are observed between plasma volume and osmolality and sodium changes, and between vasopressin and osmolality and sodium content changes. Data thus support the hypotheses that (1) vasopressin may be the primary controlling endocrine for fluid and electrolyte levels following exercise; (2) an exercise intensity greater than 40% maximal aerobic capacity is required to stimulate vasopressin release through changes in plasma osmolality; and (3) the stimulation of the renin-angiotensin system is a more general stress response. A.L.W.

A81-24962 * Mitochondrial role in cell aging. J. Miquel, J. Fleming (NASA, Ames Research Center, Moffett Field, Calif.), A. C. Economos (San Jose State University, San Jose, Calif.), and J. E. Johnson, Jr. (Hitachi, Nissei Sangyo America, Ltd., Rockville, Md.). *Experimental Gerontology*, vol. 15, 1980, p. 575-591. 130 refs.

The experimental studies on the mitochondria of insect and mammalian cells are examined with a view to an analysis of intrinsic mitochondrial senescence, and its relation to the age-related changes in other cell organelles. The fine structural and biochemical data support the concept that the mitochondria of fixed postmitotic cells may be the site of intrinsic aging because of the attack by free radicals and lipid peroxides originating in the organelles as a by-product of oxygen reduction during respiration. Although the cells have numerous mechanisms for counteracting lipid peroxidation injury, there is a slippage in the antioxidant protection. Intrinsic mitochondrial aging could thus be considered as a specific manifestation of oxygen toxicity. It is proposed that free radical injury renders an increasing number of the mitochondria unable to divide, probably because of damage to the lipids of the inner membrane and to mitochondrial DNA. L.S.

A81-24963 * Antihistamine effect on synaptosomal uptake of serotonin, norepinephrine and dopamine. P. A. Brown and J. Vernikos (NASA, Ames Research Center, Biomedical Research Div., Moffett Field, Calif.). *European Journal of Pharmacology*, vol. 65, 1980, p. 89-92. 10 refs. Grant No. NCA2-OR-675-710.

A study on the effects of five H1 and H2 antihistamines on the synaptosomal uptake of serotonin (5HT), norepinephrine (NE), and dopamine (DA) is presented. Brain homogenates from female rats were incubated in Krebs-Ringer phosphate buffer solution in the presence of one of three radioactive neurotransmitters, and one of the five antihistamines. Low concentrations of pyrilamine competitively inhibited 5HT uptake, had little effect on NE uptake, and no effect on DA uptake. Promethazine, diphenhydramine, metiamide, and cimetidine had no effect on 5HT or DA uptake at the same concentration. Diphenhydramine had a small inhibitory effect on NE uptake. It is concluded that pyrilamine is a selective and potent competitive inhibitor of 5HT uptake at concentrations between .05 and .5 micromolars. L.S.

A81-37285 * Hemodilution, vasopressin suppression, and diuresis during water immersion in man. J. E. Greenleaf, L. C. Keil (NASA, Ames Research Center, Biomedical Research Div., Moffett Field, Calif.), and E. Shvartz (Douglas Aircraft Co., Long Beach, Calif.). *Aviation, Space, and Environmental Medicine*, vol. 52, June 1981, p. 329-336. 38 refs.

The possible role of hemodilution in the early stages of water immersion in the suppression of antidiuretic hormone (vasopressin) and subsequent diuresis in man is investigated. Parameters characterizing hemodilution as well as water balance and intercompartmental fluid levels were measured before, during and after the immersion of ten subjects in a semireclining position in tap water up to their necks at 34.6 °C for 8 hr. Results indicate that hemodilution and the suppression of vasopressin and plasma renin activity were present by the second hour of immersion, with the early hemodilution due to a slight increase in plasma volume with no change in plasma sodium or osmotic contents, even though urine volume and osmotic excretion rates increased significantly. Hyponatremia, hyposmolality and plasma renin activity suppression are observed to continue to the end of immersion, resulting in final decreases of 15.6% in plasma volume, 18.8% in extracellular volume, 19.6% in interstitial volume and 10.7% in red cell volume. Findings suggest the transfer of hypotonic fluid into the vascular system, which contributes to vasopressin suppression observed during immersion. A.L.W.

A81-42023 * Enhanced skeletal muscle insulin sensitivity in year-old rats adapted to hypergravity. C. E. Mondon (Stanford University, Palo Alto, CA), C. B. Dolkas (U.S. Veterans Administration, Medical Center, Palo Alto, CA), and J. Oyama (NASA, Ames Research Center, Moffett Field, CA). *American Journal of Physiology*, vol. 240, 1981, p. E482-E488. 30 refs. Research supported by the U.S. Veterans Administration and NASA.

Rats induced into a hypermetabolic state by exposure to chronic (7 mo) centrifugation at 4.15 g exhibited increased glucose uptake at lower plasma insulin levels than weight-matched control animals following oral glucose administration. In order to determine the insulin sensitivity of specific tissues, the effect of exogenous insulin on glucose uptake by isolated perfused livers and hindlimb skeletal muscle from rats adapted to chronic centrifugation for one year was compared with perfused tissue from 2.5 mo-old noncentrifuged control animals of equal body weight. Metabolic glucose clearance by skeletal muscle from hypergravic rats did not prove significantly greater than control muscle when perfused in the absence of insulin (10.6 vs 8.1 microliters/min-g-muscle), but was twice as fast (23.0 vs 9.5) at perfusate insulin levels of 35 micro-U/ml. Conversely, glucose uptake by hypergravic livers was significantly decreased (P is less than 0.001) compared with control livers (10.3 vs 27.8) at perfusate insulin levels of 40 micro-U/ml. Results suggest that skeletal muscle rather than liver is primarily responsible for the enhanced sensitivity to insulin and the increased energy expenditure observed in rats subjected to hypergravity. J.F.

A81-45176 * Exercise training hypotension - Implications for plasma volume, renin, and vasopressin. J. E. Greenleaf, D. Sciaraffa, E. Shvartz, L. C. Keil, and P. J. Brock (NASA, Ames Research Center, Biomedical Research Div., Moffett Field, CA). *Journal of Applied Physiology: Respiratory, Environmental and Exercise Physiology*, vol. 51, Aug. 1981, p. 298-305. 30 refs.

The relation of changes in plasma volume, plasma renin activity and arginine vasopressin to changes in resting blood pressure during exercise training is investigated. Resting supine, sitting, and standing systolic and fifth-phase diastolic blood pressures were measured in ten men before and after an eight-day training period on a cycle ergometer in either a hot (39.8 °C) or cool (23.8 °C) environment, and compared with plasma volume, renin and vasopressin levels, heart rates, maximal oxygen uptakes, rectal temperatures and sweat rates. Following acclimatization, resting supine and sitting diastolic pressures are observed to decrease by 6 and 9 mm Hg, respectively, while no significant changes are found in the diastolic pressures of the control group or the systolic pressures of either group. Resting plasma volume is found to increase by 12.2% in the controls and by 17.6% after acclimatization following the exercise training. Results suggest that the resting hypotension produced is not attributable to changes in resting plasma volume; renin or vasopressin, although heat acclimatization, which leads to large decreases in plasma volume and increases in vasopressin and renin activity, may be useful in the treatment of hypertension. A.L.W.

A81-48056 * Effects of ethidium bromide on development and aging of *Drosophila* - Implications for the free radical theory of aging. J. E. Fleming, H. A. Leon, and J. Miquel (NASA, Ames Research Center, Biomedical Div., Moffett Field, CA). *Experimental Gerontology*, vol. 16, no. 3, 1981, p. 287-293. 18 refs.

PATENTS

N81-14613* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INDOMETHACIN-ANTIHISTAMINE COMBINATION FOR GASTRIC ULCERATION CONTROL Patent

Patricia A. Brown (San Jose State Univ.) and Joan Vernikos, inventors (to NASA) (San Jose State Univ.) Issued 28 Oct. 1980 8 p. Filed 29 Dec. 1978 Supersedes N79-14755 (17 - 05, p. 0646) Continuation-in-part of US Patent Appl. SN-850504, filed 10 Nov. 1977 Sponsored by NASA (NASA-Case-ARC-11118-2; US-Patent-4,230,717; US-Patent-Appl-SN-974476; US-Patent-Appl-SN-850504; US-Patent-Class-424-274) Avail: US Patent and Trademark Office CSCL 06E

An anti-inflammatory and analgesic composition containing indomethacin and an H2 histamine receptor antagonist in an amount sufficient to reduce gastric distress caused by the indomethacin was developed. Usable antagonists are metiamide and cimetidine.

Official Gazette of the U.S. Patent and Trademark Office

N81-29763* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SWEAT COLLECTION CAPSULE Patent

John E. Greenleaf and Robert W. Delaplaine, inventors (to NASA) Issued 26 Feb. 1981 6 p. Filed 19 Apr. 1978 Supersedes N78-22720 (16 - 13, p. 1754) (NASA-Case-ARC-11031-1; US-Patent-4,190,060; US-Patent-Appl-SN-897828; US-Patent-Class-128-760; US-Patent-Class-128-275) Avail: US Patent and Trademark Office CSCL 06B

A sweat collection capsule permitting quantitative collection of sweat is described. The device consists of a frame held immobile on the skin, a closure secured to the frame and absorbent material

located next to the skin in a cavity formed by the frame and the closure. The absorbent material may be removed from the device by removing the closure from the frame while the frame is held immobile on the skin.

Official Gazette of the U.S. Patent and Trademark Office

N81-29764* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INDOMETHACIN-ANTIHISTAMINE COMBINATION FOR GASTRIC ULCERATION CONTROL Patent

Patricia A. Brown (San Jose State Univ.) and Joan V. Danellis. Inventors (to NASA) (San Jose State Univ.) Issued 21 Jul. 1981 8 p Filed 10 Nov. 1977 Supersedes N78-11692 (16 - 02, p 236) Sponsored by NASA
(NASA-Case-ARC-11118-1; US-Patent-4,279,906;
US-Patent-Appl-SN-850504; US-Patent-Class-424-247;
US-Patent-Class-424-267; US-Patent-Class-424-274) Avail:
U.S. Patent and Trademark Office CSCL 06B

An anti-inflammatory and analgesic composition containing indomethacin and an H sub 1 or an H sub 2 histamine receptor antagonist in an amount sufficient to reduce gastric distress caused by the indomethacin is described. Usable antagonists include pyrilamine, promethazine, metiamide and cimetidine.

Official Gazette of the U.S. Patent and Trademark Office

BIOSYSTEMS DIVISION

NASA TECHNICAL MEMORANDA

N81-32852*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATED SPACEFLIGHT EFFECTS ON MATING AND PREGNANCY OF RATS

Eric E. Sabelman (California Univ. at San Francisco), Peter V. Chetirkin, and Robin M. Howard Sep. 1981 44 p refs
(NASA-TM-81326; A-8461) Avail: NTIS HC A03/MF A01 CSCL 06C

The mating of rats was studied to determine the effects of: simulated reentry stresses at known stages of pregnancy, and full flight simulation, consisting of sequential launch stresses, group housing, mating opportunity, diet, simulated reentry, and postreentry isolation of male and female rats. Uterine contents, adrenal mass and abdominal fat as a proportion of body mass, duration of pregnancy, and number and sex of offspring were studied. It is found that: (1) parturition following full flight simulation was delayed relative to that of controls; (2) litter size was reduced and resorptions increased compared with previous matings in the same group of animals; and (3) abdominal fat was highly elevated in animals that were fed the Soviet paste diet. It is suggested that the combined effects of diet, stress, spacecraft environment, and weightlessness decreased the probability of mating or of viable pregnancies in the Cosmos 1129 flight and control animals. E.A.K.

N81-19412*# Flight Dynamics Research Corp., Van Nuys, Calif.
JET-DIFFUSER EJECTOR - ATTACHED NOZZLE DESIGN Final Report

Morton Alperin and Jiunn-Jeng Wu May 1980 41 p refs
Sponsored in part by Navy
(Contract NAS2-10059)
(NASA-CR-152361) Avail: NTIS HC A03/MF A01 CSCL 20D

Attached primary nozzles were developed to replace the detached nozzles of jet-diffuser ejectors. Slotted primary nozzles located at the inlet lip and injecting fluid normal to the thrust axis, and rotating the fluid into the thrust direction using the Coanda Effect were investigated. Experiments indicated excessive skin friction or momentum cancellation due to impingement of opposing jets resulted in performance degradation. This indicated a desirability for location and orientation of the injection point at positions removed from the immediate vicinity of the inlet surface, and at an acute angle with respect to the thrust axis. Various nozzle designs were tested over a range of positions and orientations. The problems of aircraft integration of the ejector, and internal and external nozzle losses were also considered and a geometry for the attached nozzles was selected. The effect of leaks, protrusions, and asymmetries in the ejector surfaces was examined. The results indicated a relative insensitivity to all surface irregularities, except for large protrusions at the throat of the ejector. J.M.S.

NASA CONTRACTOR REPORTS

N81-12627*# Desert Research Inst., Reno, Nev. Atmospheric Science Center.

INVESTIGATIONS RELATED TO EVALUATION OF ULTRA-MICROFLUOROMETER Final Report, 1 Nov. 1979 - 31 Dec. 1980

Bruce Whitcomb Feb. 1981 43 p refs
(Contract NAG2-14)
(NASA-CR-163972) Avail: NTIS HC A03/MF A01 CSCL 06B

High resolution emission and excitation fluorescent spectra were obtained for several samples in an effort to determine the optimum operational design for the instrument. The instrument was used to determine the required nature of a sample which could be detected, and in so doing, several different sample preparation techniques were considered. Numerous experiments were performed to determine the capabilities of the instrument with regard to the detection of suitably prepared virus specimens. Significant results were obtained in several areas. The fluorescent spectra indicated that substantial changes in the laser might be used advantageously to greatly improve the performance of the instrument. In the existing configuration, the instrument was shown to be capable of detecting the presence of suitably prepared virus samples. Author

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-12232 * Effect of weightlessness and centrifugation on red cell survival in rats subjected to space flight. H. A. Leon (NASA, Ames Research Center, Biomedical Research Div., Moffett Field, Calif.), L. V. Serova (Ministerstvo Zdravookhraneniia SSSR, Institut Mediko-Biologicheskikh Problem, Moscow, USSR), and S. A. Landaw (U.S. Veterans Administration, Medical Center, Syracuse, N.Y.). *Aviation, Space, and Environmental Medicine*, vol. 51, Oct. 1980, p. 1091-1094. 13 refs.

Rats were flown aboard the Soviet biosatellite Cosmos 936 for 18.5 d during August, 1977. Five rats were subjected to near-weightless space flight, as with Cosmos 782, and five rats were subjected to a 1-G force via an on-board centrifuge. These rats and three control groups were injected with 2-(C-14) glycine 19 d preflight. The flight rats were recovered from orbit after 18.5 d of space flight. Erythrocyte hemolysis and lifespan were evaluated in the five groups of rats by quantitation of radioactive carbon monoxide exhaled in the breath which arises from the breakdown of the previously labeled hemoglobin. The results support the previous findings wherein hemolysis was found to increase as a result of weightless space flight. A comparison to the centrifuged animals indicates that artificial gravity attenuates the effect of weightlessness

on hemolysis and appears to normalize the hemolytic rate in the early postflight period. (Author)

A81-34050 * Heart rate, multiple body temperature, long-range and long-life telemetry system for free-ranging animals. G. F. Lund, R. M. Westbrook, and T. B. Fryer (NASA, Ames Research Center, Moffett Field, Calif.). *Biotelemetry and Patient Monitoring*, vol. 7, no. 3-4, 1980, p. 137-177. 33 refs. Grant No. NSG-2293.

The design details and rationale for a versatile, long-range, long-life telemetry data acquisition system for heart rates and body temperatures at multiple locations from free-ranging animals are presented. The design comprises an implantable transmitter for short to medium range transmission, a receiver retransmitter collar to be worn for long-range transmission, and a signal conditioner interface circuit to assist in signal discrimination and demodulation of receiver or tape-recorded audio outputs. Implanted electrodes are used to obtain an ECG, from which R-wave characteristics are selected to trigger a short RF pulse. Pulses carrying heart rate information are interrupted periodically by a series of pulse interval modulated RF pulses conveying temperature information sensed at desired locations by thermistors. Pulse duration and pulse sequencing are used to discriminate between heart rate and temperature pulses as well as radio frequency interference. The implanted transmitter may be used alone for medium and short-range tracking, or with a receiver-transmitter collar that employs commercial tracking equipment for transmissions of up to 12 km. A system prototype has been tested on a dog. A.L.W.

CONFERENCE AND MEETING PAPERS

A81-44386 * Life sciences flight experiments program - Overview. W. E. Berry (NASA, Ames Research Center, Life Sciences Flight Experiments Projects Office, Moffett Field, CA) and C. C. Dant (Management and Technical Services Co., Moffett Field, CA). In: *Material and process applications - Land, sea, air, space; Proceedings of the Twenty-sixth National Symposium and Exhibition, Los Angeles, CA, April 28-30, 1981*. (A81-44326 21-23) Azusa, CA, Society for the Advancement of Material and Process Engineering, 1981, p. 728-737.

The considered LSFE program focuses on Spacelab life sciences missions planned for the 1984-1985 time frame. Life Sciences Spacelab payloads, launched at approximately 18-months intervals, will enable scientists to test hypotheses from such disciplines as vestibular physiology, developmental biology, biochemistry, cell biology, plant physiology, and a variety of other life sciences. An overview is presented of the LSFE program that will take advantage of the unique opportunities for biological experimentation possible on Spacelab. Program structure, schedules, and status are considered along with questions of program selection, and the science investigator working groups. A description is presented of the life sciences

laboratory equipment program, taking into account the general purpose work station, the research animal holding facility, and the plant growth unit. G.R.

A81-47389 * Development of an Animal Holding Facility for Space Shuttle studies. W. E. Berry, G. H. Bowman (NASA, Ames Research Center, Life Sciences Flight Experiments Projects Office, Moffett Field, CA), R. B. Jagow, and T. M. Olcott (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-171*. 15 p.

The modular Research Animal Holding Facility (RAHF) developed by NASA is described. Besides providing general housing for various animal species, the RAHF is designed to minimize disturbance of the specimens caused by vehicle and mission operations. The RAHF system offers life-sustaining capabilities, such as food, water, and waste removal, as well as environmental control. Modularity of construction to accommodate a variety of small animals and associated instrumentation ensures continued use of RAHF as the sophistication of experiments increases on subsequent missions. C.R.

PATENTS

N81-14612* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SUBCUTANEOUS ELECTRODE STRUCTURE Patent

Gordof F. Lund, inventor (to NASA) (NAS-NRC) Issued 26 Aug. 1980 5 p Filed 16 Jan. 1979 Supersedes N79-15576 (17-06, p 0765) Sponsored by NASA (NASA-Case-ARC-11117-1; US-Patent-4,219,027; US-Patent-Appl-SN-003693; US-Patent-Class-128-642) Avail: US Patent and Trademark Office CSCL 06B

A subcutaneous electrode structure suitable for a chronic implant and for taking a low noise electrocardiogram of an active animal, comprises a thin inflexible, smooth disc of stainless steel having a diameter as of 5 to 30 mm, which is sutured in place to the animal being monitored. The disc electrode includes a radially directed slot extending in from the periphery of the disc for approximately 1/3 of the diameter. Electrical connection is made to the disc by means of a flexible lead wire that extends longitudinally of the slot and is woven through apertures in the disc and held at the terminal end by means of a spot welded tab. Within the slot, an electrically insulative sleeve, such as silicone rubber, is placed over the wire. The wire with the sleeve mounted thereon is captured in the plane of the disc and within the slot by means of crimping tabs extending laterally of the slot and over the insulative wire. The marginal lip of the slot area is apertured and an electrically insulative potting material such as silicone rubber, is potted in place overlaying the wire slot region and through the apertures.

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EXTRATERRESTRIAL RESEARCH DIVISION

NASA TECHNICAL MEMORANDA

N81-21990* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PLASMAS IN SATURN'S MAGNETOSPHERE

L. A. Frank, B. G. Burek, K. L. Ackerson, J. H. Wolfe and J. D. Mihalov Apr. 1980 61 p refs Submitted for publication Prepared in cooperation with Iowa Univ., Iowa City (Grant NGL-16-001-002)

(NASA-TM-82345; AD-A096079; U-of Iowa-80-12) Avail: NTIS HC A04/MF A01 CSCL 03/2

The solar wind plasma analyzer on board Pioneer 2 provides first observations of low-energy positive ions in the magnetosphere of Saturn. Measurable intensities of ions within the energy-per-unit charge (E/Q) range 100 eV to 8 keV are present over the planetocentric radial distance range about 4 to 16 R sub S in the dayside magnetosphere. The plasmas are found to be rigidly corotating with the planet out to distances of at least 10 R sub S. At radial distances beyond 10 R sub S, the bulk flows appear to be in the corotation direction but with lesser speeds than

those expected from rigid corotation. At radial distances beyond the orbit of Rhea at 8.8 R sub S, the dominant ions are most likely protons and the corresponding typical densities and temperatures are 0.5/cu cm and 1,000,000 K, respectively, with substantial fluctuations. It is concluded that the most likely source of these plasmas in the photodissociation of water frost on the surface of the ring material with subsequent ionization of the products and radially outward diffusion. The presence of this plasma torus is expected to have a large influence on the dynamics of Saturn's magnetosphere since the pressure ratio beta of these plasmas approaches unity at radial distances as close to the planet as 6.5 R sub S. On the basis of these observational evidences it is anticipated that quasi-periodic outward flows of plasma, accompanied with a reconfiguration of the magnetosphere beyond about 6.5 R sub S, will occur in the local night sector in order to relieve the plasma pressure from accretion of plasma from the rings. GRA

NASA CONTRACTOR REPORTS

N81-16175*# Hamilton Standard, Windsor Locks, Conn.
PHASE DIAGRAM OF KHF2 AND NON-EQUILIBRIUM EFFECTS Final Report

Melvin C. Hobson and Jordan D. Kellner Oct. 1978 55 p refs

(Contract NAS2-9273)

(NASA-CR-152192; SVHSER-7206; R78-313686-8) Avail: NTIS HC A04/MF A01 CSCL 07D

The equilibrium diagram for the KHF2-H2O system was constructed from cooling and heating curves for the compositions between 5 wt% and 40 wt% KHF2 and the results are shown. The phase diagrams shown is typical of that of a two component system with miscible liquid phases and whole solid phases consist of pure components. A eutectic point was found at approximately 15% KHF2 which remains completely liquid down to a temperature of -9.0 C. No hydrate formation was observed and no anomalous behavior such as the occurrence of solid transitions or metastable states was observed. The effect of rapid freezing on the equilibrium diagram did not appear, and cooling curves exhibited only one halt. Also, at rapid freezing rates, the supercooling of the solutions was smaller than those observed at the slow cooling rates. The existence of a eutectic composition and the slow rate of dissolution of the salt are used to interpret heat absorption behavior in practical applications of the KHF2-H2O system. J.M.S.

N81-16740*# Acurex Corp., Mountain View, Calif. Aerospace Systems Div.

FURTHER STUDY FOR FABRICATION, EVALUATION, AND TESTING OF MONOLAYER WOVEN MATERIALS FOR SPACE SUIT INSULATION Final Report

Robert Short Sep. 1980 12 p

(Contract NAS2-10542; Acurex Proj. 6246)

(NASA-CR-166140; ACUREX-TR-80-31/AS) Avail: NTIS HC A02/MF A01 CSCL 06K

Improvements to the monolayer woven pile concept were evaluated in terms of increased durability and thermal performance. Three varieties of the monolayer material were tested for thermal conductance under various conditions simulating those which occur in space. In addition, the tendency of the pile to unravel was subjectively evaluated. E.D.K.

N81-16741*# Vought Corp., Dallas, Tex.
DEVELOPMENT AND FABRICATION OF AN ADVANCED LIQUID COOLING GARMENT Final Report

C. W. Hixon 6 Mar. 1978 87 p

(Contract NAS2-9026)

(NASA-CR-152101; Rept-2-53200/8R-3462) Avail: NTIS HC A05/MF A01 CSCL 06G

A tube/fin concept liquid cooling garment head cooler was developed, fabricated and delivered to NASA-ARC. The head cooler was fabricated from polyurethane film which sandwiches the transport fluid tubing and a thermally conductive fin material. The head cooler garment is sewn to form a skull cap and covered with a comfort liner. In addition, two Neonate heating garments were fabricated and supplied to NASA for further finishing and use in medical tests. The resulting garment is flexible, elastic and conforms to the head comfortably. Tests on a tube/fin element of identical construction as the head cooler demonstrated good thermal effectiveness. Use of commercially available materials and development of relatively simple fabrication techniques give the potential for a low garment cost. Author

N81-18634*# Santa Clara Univ., Calif.

PRELIMINARY REPORT: BIOMEDICAL CONSIDERATIONS FOR FUTURE MANNED SPACE FLIGHTS

Faren Ray Akins 1 Oct. 1978 93 p refs

(Contract NCA2-OR685-805)

(NASA-CR-152383) Avail: NTIS HC A05/MF A01 CSCL 06P

The behavioral, psychological, and sociological aspects of space travel, particularly with emphasis on longer duration missions, are discussed along with the biomedical aspects of space flight. These factors may strongly interact with the various psycho-social factors and as such they stand as an immensely important area of concern in and of themselves. A foundation for understanding weightlessness related medical problems through a discussion of the history of symptoms reported specific details on the major areas of concern and approaches to their investigation are presented. Also, discussion is given to the possibility of various countermeasures. Some indication of the effects of various biomedical changes in performance are also covered. T.M.

N81-18650*# California Univ., Davis.

PRELIMINARY REPORT ON SMALL GROUP FACTORS IN LONG DURATION SPACE FLIGHTS: REVIEW AND DIRECTIONS FOR FUTURE RESEARCH

Albert A. Harrison Sep. 1979 54 p refs

(Contract NCA2-OR180-803)

(NASA-CR-152385) Avail: NTIS HC A04/MF A01 CSCL 05I

Group dynamics, sociological and psychological factors are examined. Crew composition and compatibility are studied. Group dynamics analysis includes: leadership; cohesiveness; conformity; and conflict. S.F.

N81-18651*# Santa Clara Univ., Calif.

PERFORMANCE CONSIDERATIONS IN LONG-TERM SPACEFLIGHT

Faren R. Akins Sep. 1979 93 p refs

(Contract NCA2-OR685-805)

(NASA-CR-152384) Avail: NTIS HC A05/MF A01 CSCL 05I

Maintenance of skilled performance during extended space flight is of critical importance to both the health and safety of crew members and to the overall success of mission goals. An examination of long term effects and performance requirements is therefore a factor of immense importance to the planning of future missions. Factors that were investigated include: definition of performance categories to be investigated; methods for assessing and predicting performance levels; in-flight factors which can affect performance; and factors pertinent to the maintenance of skilled performance. T.M.

N81-18652*# Santa Clara Univ., Calif.

PRELIMINARY REPORT: ISSUES IN SELECTION AND TRAINING FOR LONG DURATION SPACE FLIGHT

Faren R. Akins Oct. 1979 94 p refs
(Contract NCA2-OR180-805)
(NASA-CR-152386) Avail: NTIS HC A05/MF A01 CSCL
051

Based on previous experience with crew selection, three important avenues of consideration for future missions are discussed: technical qualifications and expertise; medical fitness and ability to tolerate the various conditions of space; and psychological considerations including personality structure, motivation, intelligence, leadership potential, group compatibility, etc. Primary emphasis was given to the psychological considerations. T.M.

N81-18653* California Univ., Davis.
PRELIMINARY REPORT ON SOCIAL PSYCHOLOGICAL FACTORS IN LONG DURATION SPACE FLIGHTS: REVIEW AND DIRECTIONS FOR FUTURE RESEARCH
Albert A. Harrison Sep. 1978 99 p refs
(Contract NCA2-OR180-803)
(NASA-CR-152382) Avail: NTIS HC A05/MF A01 CSCL
051

Group dynamics, sociological and psychological factors are examined. Crew composition and compatibility are studied. Group dynamics analysis includes: leadership; cohesiveness; conformity; and conflict. S.F.

N81-18655* Umpqua Research Co., Myrtle Creek, Ore.
DESIGN AND FABRICATION OF A FOUR-MAN CAPACITY URINE WICK EVAPORATOR SYSTEM Final Report
1 Nov. 1979 38 p
(Contract NAS2-9677)
(NASA-CR-152226) Avail: NTIS HC A03/MF A01 CSCL
06K

The integrated system was tested to determine the performance characteristics and limitations of the dual catalyst concept. The primary objective of the dual catalyst concept is to remove ammonia and other noxious substances in the gas phase and thereby eliminate the need for and current practice of chemically or electrochemically pretreating urine prior to distillation. T.M.

N81-18656* Life Systems, Inc., Cleveland, Ohio.
FAULT DIAGNOSTIC INSTRUMENTATION DESIGN FOR ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS Final Report
P. Y. Yang, K. C. You, R. A. Wynveen, and J. D. Powell, Jr.
Oct. 1979 63 p refs
(Contract NAS2-10050)
(NASA-CR-152309; LSI-TR-361-5) Avail: NTIS
HC A04/MF A01 CSCL 06K

As a development phase moves toward flight hardware, the system availability becomes an important design aspect which requires high reliability and maintainability. As part of continuous development efforts, a program to evaluate, design, and demonstrate advanced instrumentation fault diagnostics was successfully completed. Fault tolerance designs for reliability and other instrumentation capabilities to increase maintainability were evaluated and studied. T.M.

N81-21251* SRI International Corp., Menlo Park, Calif.
A TACTILE-OUTPUT PAGING COMMUNICATION SYSTEM FOR THE DEAF-BLIND
James A. Baer Dec. 1979 71 p refs
(Contract NAS2-8711)
(NASA-CR-152332) Avail: NTIS HC A04/MF A01 CSCL
17B

A radio frequency paging communication system that has coded vibrotactile outputs suitable for use by deaf-blind people

was developed. In concept, the system consists of a base station transmitting and receiving unit and many on-body transmitting and receiving units. The completed system has seven operating modes: fire alarm; time signal; repeated single character Morse code; manual Morse code; emergency aid request; operational status test; and message acknowledge. The on-body units can be addressed in three ways: all units; a group of units; or an individual unit. All the functions developed were integrated into a single package that can be worn on the user's wrist. The control portion of the on-body unit is implemented by a microcomputer. The microcomputer is packaged in a custom-designed hybrid circuit to reduce its physical size. J.M.S.

N81-21770* Life Systems, Inc., Cleveland, Ohio.
FRACTIONAL CAPACITY ELECTROLYZER DEVELOPMENT FOR CO₂ AND H₂O ELECTROLYSIS
R. A. Wynveen Jun. 1980 49 p refs
(Contract NAS2-9862)
(NASA-CR-166149; LSI-TR-341-4) Avail: NTIS
HC A03/MF A01 CSCL 06K

The electrolyzer module was designed to produce 0.24 kg/d (0.53 lb/d) of breathable oxygen from the electrolysis of metabolic carbon dioxide and water vapor. The fractional capacity electrolyzer module is constructed from three electrochemical tube cells and contains only three critical seals. The module design illustrated an 84 percent reduction in the total number of seals for a one person capacity oxygen generating system based on the solid electrolyte carbon dioxide and water vapor electrolysis concept. The electrolyzer module was successfully endurance tested for 71 days. T.M.

N81-22700* Acurex Corp., Mountain View, Calif. Aerospace Systems Div.
STUDY FOR FABRICATION, EVALUATION, AND TESTING OF MONOLAYER WOVEN TYPE MATERIALS FOR SPACE SUIT INSULATION Final Report
Ellen B. Merrick May 1979 71 p
(Contract NAS2-9873)
(NASA-CR-166139; ACUREX-TR-79-156) Avail: NTIS
HC A04/MF A01 CSCL 06K

An alternative space suit insulation concept using a monolayer woven pile material is discussed. The material reduces cost and improves the durability of the overgarment, while providing protection similar to that provided by multilayer insulation (MLI). Twelve samples of different configurations were fabricated and tested for compressibility and thermal conductivity as a function of compression loading. Two samples which showed good results in the initial tests were further tested for thermal conductivity with respect to ambient pressure and temperature. Results of these tests were similar to results of the MLI tests, indicating the potential of the monolayer fabric to replace the present MLI. A seaming study illustrated that the fabric can be sewn in a structurally sound seam with minimal heat loss. It is recommended that a prototype thermal meteroid garment be fabricated. M.G.

N81-28750* Georgia Inst. of Tech., Atlanta. School of Textile Engineering.
DEVELOPMENT OF MOLDED, COATED FABRIC JOINTS: FABRIC CONSTRUCTION CRITERIA FOR A SPACESUIT ELBOW JOINT Status Report, period ending Aug. 1981
L. Howard Olson Aug. 1981 19 p refs
(Grant NSG-2356)
(NASA-CR-164629) Avail: NTIS HC A02/MF A01 CSCL
06K

The design and fabrication of a molded, coated fabric elbow joint capable of operating reliably at 8 psi internal pressure for extended periods of flexure is considered. The overall design of the joint includes: (1) selection of heatsettable fiber of sufficient strengths; (2) choosing an optimum fabric construction; (3) a fatigue resistant; flexible coating; and (4) a molding technique.

A polyester yarn of type 56 Dacron and a urethane coating system were selected. The relationships between yarn and weave parameters which lead to an optimum fabric construction for the 8 psi elbow joint are defined.
A.R.H.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-10679 * Carbonaceous chondrites. II - Carbonaceous chondrite phyllosilicates and light element geochemistry as indicators of parent body processes and surface conditions. T. E. Bunch and S. Chang (NASA, Ames Research Center, Moffett Field, Calif.). *Geochimica et Cosmochimica Acta*, vol. 44, Oct. 1980, p. 1543-1577. 111 refs.

Petrographic analyses of CM matrices characterized four phyllosilicates in Murray and Murchison meteorites and Fe- and Mg-serpentine in Nogoya. All phyllosilicates and bulk matrices show enrichment of K relative to Na when compared with bulk meteorites; the loss of Na and some Cl, and the addition of H₂O, CO₂, and water-soluble organics during alteration indicates a partially open system. Synthesis of soluble organic materials may have occurred in CM matrices before aqueous alteration of the precursive phases. Nogoya was 95% altered and has a bulk C content of 5.2%, higher than any meteorite; also, it has the lowest measured C-13/C-12 ratio of any carbonaceous chondrite except for Karoonda.
A.T.

A81-14654 * Plasmas in Saturn's magnetosphere. L. A. Frank, B. G. Burek, K. L. Ackerson (Iowa, University, Iowa City, Iowa), J. H. Wolfe, and J. D. Mihalov (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Nov. 1, 1980, p. 5695-5708. 27 refs. Grant No. NGL-16-001-002.

Passage of Pioneer 11 through Saturn's magnetosphere revealed a third magnetosphere with a high plasma abundance. The dominant ion species appears to be oxygen. The plasma is located in a large torus about Saturn, including the orbits of Dione and Tethys. The plasma are rigidly corotating with the planet to distances of at least 10 Saturn radii. Bulk flows appear to move in the corotation direction, but at speeds lower than those expected from rigid corotation. The ions appear to be the ionization products of water frost on the surface of the ring material.
V.P.

A81-18465 * Behavior of molecules on interstellar grains - Application of the Langevin equation and iterative extended Hückel. S. Aronowitz and S. Chang (NASA, Ames Research Center, Extraterrestrial Research Div., Moffett Field, Calif.). *Astrophysical Journal, Part 1*, vol. 242, Nov. 15, 1980, p. 149-164. 26 refs. NASA Order A-51416-B.

The Langevin equation was used to explore an adsorbate desorption mechanism. Calculations were performed using iterative extended Hückel on a silica model site with various small adsorbates, e.g., H, CH, OH, NO, CO. It was found that barriers to free traversal from one site to another are substantial (about 3-10 eV). A bootstrap desorption mechanism for some molecules in the process of forming at a site also became apparent from the calculations. The desorption mechanisms appear to be somewhat balanced by a counterforce - the attraction of sites for the newly desorbed molecule. The order of attraction to a silica grain site for the diatomic molecules considered was OH greater than CH greater than CO greater than NO, when these entities were sufficiently distant. The nature of the silica grain and that of the 'cold' desorption mechanism, when considered together, suggest that the abundance of very small grains might be less common than anticipated.
(Author)

A81-19572 * The visual accommodation response during concurrent mental activity. F. V. Malmstrom (Southern California, University, Los Angeles, Calif.), R. J. Randle (NASA, Ames Research Center, Moffett Field, Calif.), J. S. Bendix (Amherst College, Amherst, Mass.), and R. J. Weber (Oklahoma State University, Stillwater, Okla.). *Perception and Psychophysics*, vol. 28, no. 5, Nov. 1980, p. 440-448. 30 refs. NASA-USAF-supported research; NSF Grant No. 74-20208.

The direction and magnitude of the human visual accommodation response during concurrent mental activity are investigated. Subject focusing responses to targets at distances of 0.0 D, 3.0 D and an indeterminate distance were monitored by means of an optometer during the performance of a backwards counting task and a visual imagery task (thinking near and thinking far). In both experiments a shift in accommodation towards the visual far point is observed particularly for the near target, which increases with the duration of the task. The results can be interpreted in terms of both the capacity model of Kahneman (1973) and the autonomic arousal model of Hess and Polt (1964), and are not inconsistent with the possibility of an intermediate resting position.
A.L.W.

A81-24967 * Formate esters of 1,2-ethanediol - Major decomposition products of p-dioxane during storage. D. Jewett and J. G. Lawless (NASA, Ames Research Center, Moffett Field, Calif.). *Bulletin of Environmental Contamination and Toxicology*, vol. 25, 1980, p. 118-121. 12 refs.

Research done on detecting the contaminants of p-dioxane that cause a positive response for highly reactive acyl groups is discussed. Attention is given to the fact that the positive hydroxamate response might indicate an unsuspected hazard. It is found that all acyl groups transferred are formyl groups, and the mono- and diformates of 1,2-ethanediol are identified as major sources of this activity. It is also found that the formate esters are formed by way of peroxide intermediates. Concentrations of the formate ester group as high as 1.8 M are found in partially consumed bottles of dioxane but not in other common ethers stored under similar conditions. Attention is called to the possibility that the exposure to the glycol formates is probably much wider than expected. It is noted that by purging containers of dioxane with nitrogen each time they are opened and storing them in the cold away from light can prevent both the economic loss and possible health hazard caused by contamination with peroxide and formate ester.
C.R.

A81-26779 * The solar wind interaction with Venus - Pioneer Venus observations of bow shock location and structure. J. A. Slavin, R. C. Elphic, C. T. Russell (California, University, Los Angeles, Calif.), F. L. Scarf (TRW Defense and Space Systems Group, Redondo Beach, Calif.), J. H. Wolfe, J. D. Mihalov (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.), D. S. Intriligator (Southern California, University, Los Angeles, Calif.), L. H. Brace, H. A. Taylor, Jr., and R. E. Daniell, Jr. (NASA, Goddard Space Flight Center, Laboratory for Planetary Atmospheres, Greenbelt, Md.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 7625-7641. 88 refs. Contract No. NAS2-9491.

Pioneer Venus observations are used in carrying out a study of the location and structure of the Venus bow shock. The trace of the shock in the solar wind aberrated terminator plane is almost circular at an altitude of 1.38 Venus radii independent of interplanetary magnetic field orientation with an extrapolated subsolar height of 0.38 Venus radii. Gas dynamic relations and scaling of the terrestrial analogue are used in determining the effective impenetrable obstacle altitude from the mean shock surface with the conclusion that it lies beneath the observed height of the ionopause. The short-term variability in shock position is similar to that found at the earth; over the long-term bow shock, altitude varies by up to approximately 35% in phase with the solar cycle for reasons other than changing solar wind Mach number. In contrast to ionopause position, which is shown to be well determined by external pressure measurements, it is found that bow shock altitude is only weakly dependent on ionopause height and solar wind dynamic pressure.
C.R.

A81-26782 * The dynamic behavior of the Venus ionosphere in response to solar wind interactions. L. H. Brace, R. F. Theis, W. R. Hoegy (NASA, Goddard Space Flight Center; Greenbelt, Md.), J. H. Wolfe, J. D. Mihalov (NASA, Ames Research Center, Moffett Field, Calif.), C. T. Russell, R. C. Elphic (California, University, Los Angeles, Calif.), and A. F. Nagy (Michigan, University, Ann Arbor, Mich.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 7663-7678. 42 refs. Contract No. NAS2-9491.

The dynamics of the Venus ionosphere relates to the variations in the solar wind and the ionosheath magnetic fields as demonstrated by the electron density and temperature measurements of the Pioneer Venus orbiter electron probe. The mean ionopause height increases from 330 km at the subsolar point to 700 km at the dusk terminator, and to 1000 km at the dawn terminator; the dayside ionopause expands and contracts with solar wind pressure variations. Extreme spatial irregularities in the shape of holes, horizontally stratified layers, and detached plasma clouds are observed in the nightside ionosphere. The ion pickup on the dayside is described in terms of solar wind discontinuities inducing a wavelike pattern at the ionopause which is penetrated by the ionosheath plasma and magnetic fields which remove the plasma in the form of detached plasma clouds. A.T.

A81-26802 * Measurement of the Venus lower atmosphere composition - A comparison of results. J. H. Hoffman (Texas, University, Richardson, Tex.), V. I. Oyama (NASA, Ames Research Center, Moffett Field, Calif.), and U. von Zahn (Bonn, Universität, Bonn, West Germany). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 7871-7881. 23 refs. Bundesministerium für Forschung und Technologie Contract No. WRK-275; Contracts No. NAS2-8802; No. NAS2-9485.

The data from seven gas analyzer measurements obtained from Pioneer Venus and the Venera 11 and 12 spacecraft are compared, and the chemical composition of the atmosphere from approximately 700 km to the surface is examined. In and near the clouds, the O₂ mixing ratio is a few ten ppm, and the CO mixing ratio is 20-30 ppm. The existence of COS in the lower part of the atmosphere is doubtful, and its mixing ratio at higher altitudes does not exceed a few ppm. SO₂ may exist below the clouds at a mixing ratio of about 100 ppm, whereas in the clouds it is less than 10 ppm. A discrepancy in the data still exists for the measurement of the water vapor abundance. L.S.

A81-26804 * # Pioneer Venus gas chromatography of the lower atmosphere of Venus. V. I. Oyama, G. C. Carle, F. Woeller, J. B. Pollack, R. T. Reynolds, and R. A. Craig (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 85, Dec. 30, 1980, p. 7891-7902. 33 refs.

A gas chromatograph mounted in the Pioneer Venus sounder probe measured the chemical composition of the atmosphere of Venus at three altitudes. Ne, N₂, O₂, Ar, CO, H₂O, SO₂, and CO₂ were measured, and upper limits set for H₂, COS, H₂S, CH₄, Kr, N₂O, C₂H₄, C₂H₆, and C₃H₈. Simulation studies have provided indirect evidence for sulfuric acid-like droplets and support the possibility of water vapor at altitudes of 42 and 24 km. The paper discusses the implications of these results for the origin, evolution, and present state of Venus' atmosphere. (Author)

A81-35357 * Structure of Jupiter's magnetopause - Pioneer 10 and 11 observations. B. U. O. Sonnerup (Dartmouth College, Hanover, N.H.), E. J. Smith, B. T. Tsurutani (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and J. H. Wolfe (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Geophysical Research*, vol. 86, May 1, 1981, p. 3321-3334. 27 refs. NSF Grant No. ATM-79-20277; Grant No. NSG-7292; Contract No. NAS7-100.

The magnetic structure of Jupiter's magnetopause, as observed by the space probes Pioneer 10 and 11, is compared with terrestrial magnetopause structures from theOGO 5 mission. The Jovian magnetopause thickness, deduced from a rapid triple crossing, is found to lie in the range 3500-5200 km, while the adjoining plasma boundary layer was 5600-8400 km thick. Comparison with the terrestrial situation suggests that the dayside magnetopause thickness in both cases is a few times the ion gyroradius and that the dayside boundary layer is also of about the same width. The magnetopause normal vector and normal magnetic field component are determined for each crossing by use of minimum variance analysis. The results indicate a blunt and floppy magnetopause surface, for the most part with an insignificant normal magnetic field component. Only for three of the 14 crossings did this component exceed 1.5 times its error estimate. In two of these cases, the magnetic field tangential to the magnetopause displayed the characteristic features of a rotational discontinuity. (Author)

A81-38849 * A comparison of three liquid-ventilation cooling garments during treadmill exercise. B. Webbon, L. Miller, B. Williams (NASA, Ames Research Center, Moffett Field, CA), and L. Montgomery (LDM Associates, San Jose, CA). *Aviation, Space, and Environmental Medicine*, vol. 52, July 1981, p. 408-415. 14 refs.

A comparative study was made of the heat transfer performance and physiological effects of three different cooling garments used under sealed garments (simulating space suits) on five male subjects, during treadmill exercise. The mean exercise metabolic rate while walking at 0.9 m/s (2 mph) was 464 plus or minus 33 W. An equilibrium condition was never reached during the uncooled suited control runs and the subjects lost approximately two percent of body weight during the exercises. The mean weight loss with an Apollo-type garment was 0.35 plus or minus 0.10 kg, and 0.26 plus or minus 0.11 kg with the full-body cooling patch garment (garment 2). With the partial-coverage cooling patch (garment 3), the weight loss was 0.52 plus or minus 0.12 kg. The data showed an increase in the leg blood flow when the working muscles were not cooled by liquid flow (garment 3), and the arm blood flow remained unchanged with and without liquid cooling to the arms. E.B.

A81-42130 * Nonbonded interactions in membrane active cyclic biopolymers. IV - Cation dependence. R. Radhakrishnan, S. Srinivasan, C. V. Prasad, S. R. Brinda (Madras, University, Madras, India), R. D. MacElroy (NASA, Ames Research Center, Moffett Field, CA), and K. Sundaram. *International Journal of Quantum Chemistry, Quantum Biology Symposium* no. 7, 1980, p. 315-322. 14 refs.

Interactions of valinomycin and form of its analogs in several conformations with the central ions Li(+), Na(+), K(+), Rb(+), and Cs(+) are investigated as part of a study of the specific preference of valinomycin for potassium and the mechanisms of carrier-mediated ion transport across membranes. Ion binding energies and conformational potential energies are calculated taking into account polarization energy formulas and repulsive energy between the central ion and the ligand atoms for conformations representing various stages in ion capture and release for each of the two ring chiralities of valinomycin and its analogs. Results allow the prediction of the chirality and conformation most likely to be observed for a given analog, and may be used to synthesize analogs with a desired rigidity or flexibility. The binding energies with the alkali metal cations are found to decrease with increasing ion size, and to be smaller than the corresponding ion hydration energies. It is pointed out that the observed potassium preference may be explainable in terms of differences between binding and hydration energies. Binding energies are also noted to depend on ligand conformation. A.L.W.

A81-42138 * Interactive display of molecular models using a microcomputer system. J. T. Egan and R. D. MacElroy (NASA, Ames Research Center, Moffett Field, CA). *Computer Programs in*

Biomedicine, vol. 12, Dec. 1980, p. 203-211. 16 refs.

A simple, microcomputer-based, interactive graphics display system has been developed for the presentation of perspective views of wire frame molecular models. The display system is based on a TERA 8510a graphics computer system with a display unit consisting of microprocessor, television display and keyboard subsystems. The operating system includes a screen editor, file manager, PASCAL and BASIC compilers and command options for linking and executing programs. The graphics program, written in USCD PASCAL, involves the centering of the coordinate system, the transformation of centered model coordinates into homogeneous coordinates, the construction of a viewing transformation matrix to operate on the coordinates, clipping invisible points, perspective transformation and scaling to screen coordinates; commands available include ZOOM, ROTATE, RESET, and CHANGEVIEW. Data file structure was chosen to minimize the amount of disk storage space. Despite the inherent slowness of the system, its low cost and flexibility suggests general applicability. A.L.W.

A81-42226 * Poly(vinyl alcohol) membranes for reverse osmosis. M. G. Katz and T. Wydeven, Jr. (NASA, Ames Research Center, Moffett Field, CA). In: Synthetic membranes. Volume 1 - Desalination. Washington, DC, American Chemical Society (ACS Symposium Series, No. 153), 1981, p. 383-398. 7 refs.

A description is presented of the results of studies of the water and salt transport properties of PVA membranes, taking into account radiation crosslinked PVA membranes, diffusive salt permeability through PVA membranes, and heat treated PVA membranes. The experimental findings support an occurrence of independent water, and salt permeation processes. It is suggested that the salt permeation is governed by a solution-diffusion transport mechanism. The preparation of thin skinned, asymmetric PVA membranes is also discussed. The employed method has a certain similarity to the classical phase inversion method, which is widely applied in the casting of asymmetric reverse osmosis membranes. Instead of using a gelling bath composed of a nonsolvent for the membrane material and miscible with the solvent from which the membrane is cast, a 'complexing' bath is used, which is a solution of a complexing agent in water. G.R.

A81-44011 * Compression of Jupiter's magnetosphere by the solar wind - Reexamination via MHD simulation of evolving corotating interaction regions. Z. K. Smith, M. Dryer (NOAA, Space Environment Laboratory, Boulder, CO), R. W. Fillius (California, University, La Jolla, CA), E. J. Smith (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and J. H. Wolfe (NASA, Ames Research Center, Moffett Field, CA). *Journal of Geophysical Research*, vol. 86, Aug. 1, 1981, p. 6773-6780. 30 refs. Contracts No. NAS7-100; No. NAS2-6552.

Major changes in the solar wind before, during and after the Pioneer 10 and 11 missions' encounter with the Jovian magnetosphere are considered. A numerical simulation of the multiple corotating interaction region (CIR) evolutions from one spacecraft to its sister spacecraft is shown to have confirmed the suggestion by Smith et al (1978) that Jupiter's magnetosphere was compressed by interplanetary CIRs during three out of four of the observed events. The MHD simulation presented suggests that the Jupiter magnetosphere reacts to solar wind rarefactions by expanding. A pair of previously unexplained magnetopause crossings of the Pioneer 11 outbound pass may be due to a delayed reexpansion of the Jupiter magnetosphere from a compression that occurred during the inbound pass. O.C.

A81-44066 * The carbon isotope biogeochemistry of the individual hydrocarbons in bat guano and the ecology of the insectivorous bats in the region of Carlsbad, New Mexico. D. J. Des

Marais (NASA, Ames Research Center, Moffett Field, CA), J. M. Mitchell, W. G. Meinschein, and J. M. Hayes (Indiana University, Bloomington, IN). *Geochimica et Cosmochimica Acta*, vol. 44, Dec. 1980, p. 2075-2086. 42 refs. Grant No. NGR-15-003-118.

The structures and C-13 contents of individual hydrocarbons extracted from bat guano found in the Carlsbad region of New Mexico are analyzed in order to elucidate details of the carbon flow in the plant-insect-bat ecosystem. Carbon isotopic analyses indicate that equivalent numbers of plants with C3 and C4 photosynthetic pathways occupy the feeding area of the bats, which supports alfalfa and cotton as well as native plants. The molecular composition of the guano is consistent with an origin in two distinct populations of insects with different feeding habits, one of which may graze predominantly on crops. It is also pointed out that isotopic analyses of more ancient guano deposits may be useful in characterizing prevalent vegetation and climate of earlier periods. A.L.W.

A81-45234 * Molecular carbon isotopic evidence for the origin of geothermal hydrocarbons. D. J. Des Marais (NASA, Ames Research Center, Moffett Field, CA), J. H. Donchin, N. L. Nehring, and A. H. Truesdell (U.S. Geological Survey, Menlo Park, CA). *Nature*, vol. 292, Aug. 27, 1981, p. 826-828. 16 refs.

Isotopic measurements of individual geothermal hydrocarbons that are, as a group, of higher molecular weight than methane are reported. It is believed in light of this data that the principal source of hydrocarbons in four geothermal areas in western North America is the thermal decomposition of sedimentary or groundwater organic matter. O.C.

A81-46438 * Water vapor resistance of plasma-polymerized coatings on potassium bromide windows. T. Wydeven and C. C. Johnson (NASA, Ames Research Center, Moffett Field, CA). (ACS, Chemical Institute of Canada, Mexican Chemical Society, Mexican Institute of Chemical Engineering, and Mexican Pharmaceutical Association, Chemical Congress, 2nd, Las Vegas, NV, Aug. 24-29, 1980.) *Polymer Engineering and Science*, vol. 21, no. 11, Aug. 1981, p. 650-657. 18 refs. Army-sponsored research.

Plasma-polymerized tetrafluoroethylene (PPTFE) coated potassium bromide IR window are shown to possess better resistance to moisture than either ethylene or chlorotrifluoroethylene. The PPTFE-coated windows tolerated an upper limit relative humidity of about 80% at 297 K, without visible damage to either window or coating, over a period of 24 hours. Elemental analysis of the bulk, and photoelectron spectroscopy of the coating surface, showed that PPTFE coatings deposited downstream of the internal plasma reactor electrodes contained less atmospheric oxygen than coatings deposited between the electrodes; perhaps accounting for the improved moisture resistance. O.C.

CONFERENCE AND MEETING PAPERS

A81-18426 * A search strategy for SETI - The search for extraterrestrial intelligence. J. Billingham, J. Wolfe (NASA, Ames Research Center, Moffett Field, Calif.), R. Edelson (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), GTE Laboratories, Waltham, Mass.), S. Gulkis, E. Olsen (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), B. Oliver (Hewlett Packard Corp., Palo Alto, Calif.), J. Tarter (California, University, Berkeley, Calif.), and C. Seeger (San Francisco State University, San Francisco, Calif.). *International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-28, 1980, Paper 80-IAA-57*. 14 p. 7 refs.

A search strategy is proposed for the detection of signals of extraterrestrial intelligent origin. It constitutes an exploration of a well defined volume of search space in the microwave region of the

spectrum and envisages the use of a combination of sky survey and targeted star approaches. It is predicated on the use of existing antennas equipped with sophisticated multichannel spectrum analyzers and signal processing systems operating in the digital mode. The entire sky would be surveyed between 1 and 10 GHz with resolution bin widths down to 32 Hz. More than 700 nearby solar type stars and other selected interesting directions would be searched between 1 GHz and 3 GHz with bin widths down to 1 Hz. Particular emphasis would be placed on those solar type stars that are within 20 light years of earth. (Author)

A81-26605 * The recognition of extraterrestrial artificial signals. C. L. Seeger (NASA, Ames Research Center, SETI Program Office, Moffett Field; San Francisco State University, San Francisco, Calif.). In: Asilomar Conference on Circuits, Systems, and Computers, 13th, Pacific Grove, Calif., November 5-7, 1979, Conference Record. (A81-26601 10-63) Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1980, p. 18-22.

Considerations in the design of receivers for the detection and recognition of artificial microwave signals of extraterrestrial origin are discussed. Following a review of the objectives of SETI and the probable reception and detection characteristics of extraterrestrial signals, means for the improvement of the sensitivity, signal-to-noise ratios and on-line data processing capabilities of SETI receivers are indicated. The characteristics of the signals likely to be present at the output of an ultra-low-noise microwave receiver are then examined, including the system background noise, terrestrial radiations, astrophysical radiations, accidental artificial radiations of terrestrial origin, and intentional radiations produced by humans and by extraterrestrial intelligence. The classes of extraterrestrial signals likely to be detected, beacons and leakage signals, are considered, and options in the specification of gating and thresholding for a high-spectral resolution, high-time-resolution signal discriminator are indicated. Possible tests for the nonhuman origin of a received signal are also pointed out. A.L.W.

A81-42227 * Modelling of DNA-protein recognition. R. Rein, R. Garduno, S. Colombano, S. Nir, K. Haydock (Roswell Park Memorial Institute, Buffalo; New York State University, Amherst, NY), and R. D. MacElroy (NASA, Ames Research Center, Moffett Field, CA; Roswell Park Memorial Institute, Buffalo; New York State University, Amherst, NY). In: Biomolecular structure, conformation, function and evolution. Volume 2 - Physico-chemical and theoretical studies. Oxford and New York, Pergamon Press, 1980, p. 387-395. 21 refs. Grants No. NCA2-OR-635-701; No. NSG-7305.

Computer model-building procedures using stereochemical principles together with theoretical energy calculations appear to be, at this stage, the most promising route toward the elucidation of DNA-protein binding schemes and recognition principles. A review of models and bonding principles is conducted and approaches to modeling are considered, taking into account possible di-hydrogen-bonding schemes between a peptide and a base (or a base pair) of a double-stranded nucleic acid in the major groove, aspects of computer graphic modeling, and a search for isogeometric helices. The energetics of recognition complexes is discussed and several models for peptide DNA recognition are presented. G.R.

A81-47442 * Ten years of the international review meetings on Communication with Extraterrestrial Intelligence /CETI/. R. Pesek (Ceskoslovenska Akademie Ved, Prague, Czechoslovakia) and J. Billingham (NASA, Ames Research Center, Moffett Field, CA). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-296.* 24 p. 77 refs.

The development of ideas on CETI within the international community over the past five years is reviewed, and the outlook for

future CETI activities is discussed. The growth of review sessions on CETI held annually by the International Academy of Astronautics (IAA) is considered, with particular attention given to the issue of radio frequency allocation for the search for extraterrestrial intelligence. CETI activities outside the IAA are then examined, including the Viking search for life on Mars, Project Orion for the detection of extrasolar planetary systems, SETI programs undertaken in the U.S. and Soviet Union, and the development of multispectral spectrum analyzers and signal processors. The expected future development of CETI strategies, techniques and instrumentation as well as popular and scientific interest in SETI are discussed, and it is noted that the IAA sessions remain the only regular international forum for the exchange of data on all aspects of CETI. A.L.W.

A81-47445 * The demography of extraterrestrial civilizations. J. Billingham (NASA, Ames Research Center, Moffett Field, CA). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-304.* 7 p. 12 refs.

Studies carried out within the last ten years on the nature and distribution of extraterrestrial intelligent life are reviewed. Arguments for the absence of intelligent life in the Galaxy based on the assumption that at least some of these would have engaged in colonization and for the presence of colonies of extraterrestrials in some undiscovered location in the solar system are presented, and it is noted that both these views rest on the notion that interstellar travel can be achieved at high velocities in very large vehicles, which has been questioned. Alternative suggestions concerning interstellar exploration by automated probes and the possible extended time scale and motivation for galactic colonization are pointed out. Attention is then given to arguments for the extreme smallness of one of the factors in the Drake equation used to estimate the number of communicative extraterrestrial civilizations in the Galaxy, including the frequency of single stars, the likelihood that planets with the correct initial composition and conditions for life are at the proper distance from their stars, the probability of the formation of DNA and the origin of life, and the time for the evolution of intelligence. It is concluded that it seems likely that other civilizations exist in the Galaxy, although the number and distribution of such civilizations may only be determined by the detection of one or more examples. A.L.W.

PATENTS

N81-17433* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PRESSURE CONTROL VALVE Patent

Kenneth H. Lambson, inventor (to NASA) Issued 16 Dec. 1980 5 p. Filed 13 Jul. 1979 Supersedes N79-30553 (17 - 21, p. 2817)

(NASA-Case-ARC-11251-1; US-Patent-4,239,057;

US-Patent-Appl-SN-057485; US-Patent-Class-137-549;

US-Patent-Class-251-339; US-Patent-Class-251-216;

US-Patent-Class-128-DIG.20; US-Patent-Class-137-886;

US-Patent-Class-137-887) Avail: US Patent and Trademark Office CSCL 13K

A control valve is provided which is adapted to be connected between a pressure source, such as a vacuum pump, and a pressure vessel so as to control the pressure in the vessel. The valve comprises a housing having a longitudinal bore which is connected between the pump and vessel, and a transversely movable valve body which controls the air flow through an air inlet in the housing. The valve body includes cylindrical and conical shaped portions which cooperate with reciprocally shaped portions of the housing to provide flow control. A filter in the air inlet removes foreign matter from the air. The bottom end of the valve body is screwed into the valve housing control knob formed integrally with the valve body and controls translation of the valve body, and the opening and closing of the valve.

Official Gazette of the U.S. Patent and Trademark Office

N81-25662* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPINE IMMOBILIZATION APPARATUS Patent

Kenneth H. Lambson (Lambson (Kenneth) and Associates) and Hubert C. Vykukal, inventors (to NASA) Issued 14 Apr. 1981 7 p Filed 13 Jul. 1979 Supersedes N79-30921 (17 - 21, p 2865)

(NASA-Case-ARC-11167-1; US-Patent-4,261,349;

US-Patent-Appl-SN-057526; US-Patent-Class-128-89R) Avail: US Patent and Trademark Office CSCL 06B

The apparatus makes use of a normally flat, flexible bladder filled with beads or micro-balloons that form a rigid mass when

the pressure within the bladder is decreased below ambient through the use of a suction pump so that the bladder can be conformed to the torso of the victim and provide the desired restraint. The bladder is strapped to the victim prior to being rigidified by an arrangement of straps which avoid the stomach area. The bladder is adapted to be secured to a rigid support, i.e., a rescue chair, so as to enable removal of a victim after the bladder has been made rigid. A double sealing connector is used to connect the bladder to the suction pump and a control valve is employed to vary the pressure within the bladder so as to soften and harden the bladder as desired.

Official Gazette of the U.S. Patent and Trademark Office

MAN-VEHICLE SYSTEMS RESEARCH DIVISION

NASA FORMAL REPORTS

N81-13635* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HEAD-UP TRANSITION BEHAVIOR OF PILOTS WITH AND WITHOUT HEAD-UP DISPLAY IN SIMULATED LOW-VISIBILITY APPROACHES

Richard F. Haines, Edith Fischer, and Toni A. Price Dec. 1980 37 p refs Prepared in cooperation with San Jose Univ. Foundation, Calif.

(NASA-TP-1720; A-8296; HUD-10) Avail: NTIS HC A03/MF A01 CSCL 05H

To quantify head-up transition behavior with and without a flightpath type head-up display, eight rated B-727 pilots each flew 31 manual and coupled approaches in a simulator with B-727 dynamics and collimated model board external scene. Data were also obtained on the roll played by the head-up display in the coupled-to-manual transition. Various wind shears, low visibilities, and ceilings were tested along with unexpected misalignment between the runway and head-up display symbology. The symbolic format used was a conformal scene. Every pilot except one stayed head-up, flying with the display after descending below the ceiling. Without the display and as altitude decreased, the number of lookups from the instrument panel decreased and the duration of each one increased. No large differences in mean number or duration of transitions up or down were found during the head-up display runs comparing the no-misalignment with the lateral instrument landing system offset misalignment runs. The head-up display led to fewer transitions after the pilot made a decision to land or execute a missed approach. Without the display, pilots generally waited until they had descended below the ceiling to look outside the first time, but with it several pilots looked down at their panel at relatively high altitudes (if they looked down at all). Manual takeover of control was rapid and smooth both with and without the display which permitted smoother engine power changes.

E.D.K.

N81-13636* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COGNITIVE ISSUES IN HEAD-UP DISPLAYS

Edith Fischer and Richard F. Haines (San Jose State Univ., Calif.) Dec. 1980 32 p refs

(NASA-TP-1711; A-8246) Avail: NTIS HC A03/MF A01 CSCL 01D

The ability of pilots to recognize and act upon unexpected information, presented in either the outside world or in a head-up display (HUD), was evaluated. Eight commercial airline pilots flew 18 approaches with a flightpath-type HUD and 13 approaches with conventional instruments in a fixed-base 727 simulator. The approaches were flown under conditions of low visibility, turbulence, and wind shear. Vertical and lateral flight performance was measured for five cognitive variables: an unexpected obstacle on runway; vertical and lateral boresight-type offset of the HUD; lateral ILS beam bend-type offset; and no anomaly. Mean response

time to the runway obstacle was longer with HUD than without it (4.13 vs 1.75 sec.), and two of the pilots did not see the obstacle at all with the HUD. None of the offsets caused any deterioration in lateral flight performance, but all caused some change in vertical tracking; all offsets seemed to magnify the environmental effects. In all conditions, both vertical and lateral tracking was better with the HUD than with the conventional instruments.

Author

N81-30101* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

GUIDELINES FOR LINE-ORIENTED FLIGHT TRAINING, VOLUME 1

John K. Lauber and H. Clayton Foushee Aug. 1981 46 p refs Proceedings of NASA/Industry Workshop, Moffett Field, Calif., 13-15 Jan. 1981

(NASA-CP-2184; A-8585-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 01C

Line-Oriented Flight Training (LOFT) is a developing training technology which synthesizes high-fidelity aircraft simulation and high-fidelity line-operations simulation to provide realistic, dynamic pilot training in a simulated line environment. LOFT is an augmentation of existing pilot training which concentrates upon command, leadership, and resource management skills. This report, based on an NASA/Industry workshop held in January, 1981, is designed to serve as a handbook for LOFT users. In addition to providing background information, guidelines are presented for designing LOFT scenarios, conducting real-time LOFT operations, pilot debriefing, and instructor qualification and training. The final chapter addressed other uses of LOFT and line-operations (or full-mission) simulation.

Author

N81-31162* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER PROBLEMS IN THE AVIATION SYSTEM

Charles E. Billings, ed. and Ed S. Cheaney, ed. Sep. 1981 95 p refs

(NASA-TP-1875; A-8567) Avail: NTIS HC A05/MF A01 CSCL 17B

Problems in the transfer of information within the aviation system are discussed. Particular attention is given to voice communication problems in both intracockpit and air/ground situations. For individual titles, see N81-31163 through N81-31169.

N81-31163* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DIMENSIONS OF THE INFORMATION TRANSFER PROBLEM

Charles E. Billings and William D. Reynard *In its Inform. Transfer Probl. in the Aviation System* Sep. 1981 p 9-14 refs (For primary document see N81-31162 22-03)
Avail: NTIS HC A05/MF A01 CSCL 17B

Several facets of the information transfer problems in aviation are described. A general analysis of these problems are given and the implications of some proposed solutions discussed. It is concluded that information transfer problems are responsible for many potentially serious human errors in aviation operations.

R.C.T.

N81-31164*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER IN THE SURFACE COMPONENT OF THE SYSTEM: PROBLEMS ASSOCIATED WITH BRIEFING OF RELIEF CONTROLLERS

Ralph L. Grayson *In its Inform. Transfer Probl. in the Aviation System* Sep. 1981 p 15-24 (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 17B

The types of human error associated with briefing of relief in air traffic control operations are described. The factors associated with these errors are examined.

R.C.T.

N81-31165*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER IN THE SURFACE COMPONENT OF THE SYSTEM: COORDINATION PROBLEMS IN AIR TRAFFIC CONTROL

Ralph L. Grayson *In its Inform. Transfer Probl. in the Aviation System* Sep. 1981 p 25-46 refs (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 17B

The significance of coordination in the air traffic control system is discussed. An attempt is made to determine the circumstances that appear to encourage coordination failures as well as examine the human and system factors involved in these failures. Possible means of reducing the rate of such failures are also considered.

R.C.T.

N81-31166*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER BETWEEN AIR TRAFFIC CONTROL AND AIRCRAFT: COMMUNICATION PROBLEMS IN FLIGHT OPERATIONS

Ralph L. Grayson and Charles E. Billings *In its Inform. Transfer Probl. in the Aviation System* Sep. 1981 p 47-61 ref (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 17B

Problems in communications between flightcrews and air traffic controllers were investigated as part of an analysis of information transfer problems in the national aviation system. Particular attention was given to problems in oral communication between pilots and controllers.

R.C.T.

N81-31167*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION TRANSFER WITHIN THE COCKPIT: PROBLEMS IN INTRACOCKPIT COMMUNICATIONS

H. Clayton Foushee and Karen L. Manos *In its Inform. Transfer Probl. in the Aviation System* Sep. 1981 p 63-71 refs (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 17B

The role of communication patterns among cockpit crew members is discussed. Emphasis is placed on information transfer problems which include: messages that are untimely; messages that are not received or understood; and less common, messages that are not transferred because of equipment failure.

R.C.T.

N81-31169*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE INFORMATION TRANSFER PROBLEM SUMMARY AND COMMENTS

Charles E. Billings and Ed S. Cheaney *In its Inform. Transfer Probl. in the Aviation System* Sep. 1981 p 85-94 refs (For primary document see N81-31162 22-03)

Avail: NTIS HC A05/MF A01 CSCL 17B

An attempt is made to illuminate the problems associated with deficiencies in the information transfer process of both intracockpit and air/ground communications. Possible steps are suggested as a means of enhancing the flow of information in the aviation system.

R.C.T.

NASA TECHNICAL MEMORANDA

N81-10021*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NASA AVIATION SAFETY REPORTING SYSTEM Quarterly Report, 1 Jan. - 31 Mar. 1979

Apr. 1980 34 p refs Prepared in cooperation with Battelle Columbus Labs., Mountain View, Calif.

(NASA-TM-81225; A-8311; QR-11) Avail: NTIS HC A03/MF A01 CSCL 01C

A comprehensive study of near midair collisions in terminal airspace, derived from the ASRS database is presented. A selection of controller and pilot reports on airport perimeter security, unauthorized takeoffs and landings, and on winter operations is presented. A sampling of typical Alert Bulletins and their responses is presented.

T.M.

N81-16022*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HUMAN FACTORS OF FLIGHT-DECK AUTOMATION: NASA/INDUSTRY WORKSHOP

Deborah A. Boehm-Davis, Renwick E. Curry, Earl L. Wiener (Miami Univ., Coral Gables, Fla.), and R. Leon Harrison Jan. 1981 26 p refs Workshop held at Burlingame, Calif., 17-18 Jul. 1980

(NASA-TM-81260; A-8432) Avail: NTIS HC A03/MF A01 CSCL 01C

The scope of automation, the benefits of automation, and automation-induced problems were discussed at a workshop held to determine whether those functions previously performed manually on the flight deck of commercial aircraft should always be automated in view of various human factors. Issues which require research for resolution were identified. The research questions developed are presented.

A.R.H.

N81-16994*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE USE OF TOTAL SIMULATOR TRAINING IN TRANSITIONING AIR-CARRIER PILOTS: A FIELD EVALUATION

Robert J. Randle, Jr., Trieve A. Tanner, Joy A. Hamerman (Ford Aerospace and Communications Corp., Sunnyvale, Calif.), and Thomas H. Showalter (Stanford Univ., Calif.) Jan. 1981 99 p refs

(NASA-TM-81250; A-8411) Avail: NTIS HC A05/MF A01 CSCL 05I

A field study was conducted in which the performance of air carrier transitioning pilots who had landing training in a landing maneuver approved simulator was compared with the performance of pilots who had landing training in the aircraft. Forty-eight trainees transitioning to the B-727 aircraft and eighty-seven trainees transitioning to the DC-10 were included in the study. The study results in terms of both objectively measured performance indicants and observer and check-pilot ratings did not demonstrate a clear distinction between the two training groups. The results suggest that, for these highly skilled transitioning pilots, a separate training module in the aircraft may be of dubious value.

T.M.

N81-23798*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PRELIMINARY STUDY OF HEAD-UP ASSESSMENT TECHNIQUES. 1: VIEWING DURATION OF INSTRUMENT PANEL AND HUD SYMBOLOGY USING A RECALL METHODOLOGY

Richard F. Haines Aug. 1978 27 p refs
(NASA-TM-78517; A-7589) Avail: NTIS HC A03/MF A01 CSCL 05H

Eight commercial pilots were shown 50 colored, high fidelity slides of a standard instrument panel (IP) with the needle positions of each instrument varying from slide to slide and then 50 slides of a head-up display (HUD) symbology format which contained an equivalent amount of flight-related information as the instrument panel slides. All stimuli were presented under controlled, static viewing conditions that allowed the measurement of the speed and accuracy with which one randomly selected flight parameter on each slide could be read. The subject did not know which parameter would be requested and, therefore, had to remember the total set of information in order to answer the question correctly. The results showed that from 6.6 - 8.7 sec total viewing time was required to correctly extract altitude, airspeed, heading, VSI, or ADI from the IP slides and from 6.1 to 7.4 sec for the HUD slides. T.M.

N81-23799*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A PRELIMINARY STUDY OF HEAD-UP DISPLAY ASSESSMENT TECHNIQUES. 2: HUD SYMBOLOGY AND PANEL INFORMATION SEARCH TIME

Joseph G. Guercio and Richard F. Haines Oct. 1978 25 p refs
(Grant NsG-2269)
(NASA-TM-78536; A-7706) Avail: NTIS HC A02/MF A01 CSCL 05H

L Twelve commercial pilots were shown 50 high-fidelity slides of a standard aircraft instrument panel with the airspeed, altitude, ADI, VSI, and RMI needles in various realistic orientations. Fifty slides showing an integrated head-up display (HUD) symbology containing an equivalent number of flight parameters as above (with flight path replacing VSI) were also shown. Each subject was told what flight parameter to search for just before each slide was exposed and was given as long as needed (12 sec maximum) to respond by verbalizing the parameter's displayed value. The results for the 100-percent correct data indicated that: there was no significant difference in mean reaction time (averaged across all five flight parameters) between the instrument panel and HUD slides; and a statistically significant difference in mean reaction time was found in responding to different flight parameters. T.M.

N81-24725*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AUTOMATION IN ORGANIZATIONS: ETERNAL CONFLICT

Duncan L. Dieterly May 1981 40 p refs Prepared in cooperation with Air Force Human Resources Lab., Moffett Field, Calif.
(NASA-TM-81290; A-8574; AFHRL-H-81-808) Avail: NTIS HC A03/MF A01 CSCL 05H

Some ideas on and insights into the problems associated with automation in organizations are presented with emphasis on the concept of automation, its relationship to the individual, and its impact on system performance. An analogy is drawn, based on an American folk hero, to emphasize the extent of the problems encountered when dealing with automation within an organization. A model is proposed to focus attention on a set of appropriate dimensions. The function allocation process becomes a prominent aspect of the model. The current state of automation research is mentioned in relation to the ideas introduced. Proposed directions for an improved understanding of automation's effect on the individual's efficiency are discussed. The importance of understanding the individual's perception of the system in terms of the degree of automation is highlighted. A.R.H.

N81-29127*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECT OF DISPLAY UPDATE INTERVAL, UPDATE TYPE, AND BACKGROUND ON PERCEPTION OF AIRCRAFT SEPARATION ON A COCKPIT DISPLAY ON TRAFFIC INFORMATION

Sharon Jago (San Jose State Univ., Calif.), Daniel Baty (San Jose State Univ., Calif.), Sharon O'Connor, and Everett Palmer Jun. 1981 12 p refs
(NASA-TM-81171; A-8070) Avail: NTIS HC A02/MF A01 CSCL 01D

The concept of a cockpit display of traffic information (CDTI) includes the integration of air traffic, navigation, and other pertinent information in a single electronic display in the cockpit. Concise display symbology was developed for use in later full-mission simulator evaluations of the CDTI concept. Experimental variables used included the update interval motion of the aircraft, the update type, (that is, whether the two aircraft were updated at the same update interval or not), the background (grid pattern or no background), and encounter type (straight or curved). Only the type of encounter affected performance. S.F.

N81-30100*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NASA AVIATION SAFETY REPORTING SYSTEM Quarterly Report

Dec. 1980 41 p refs Prepared in cooperation with Battelle Columbus Labs., Mountain View, Calif.
(NASA-TM-81252; A-8415; QR-12) Avail: NTIS HC A03/MF A01 CSCL 01C

Problems in briefing of relief by air traffic controllers are discussed, including problems that arise when duty positions are changed by controllers. Altitude reading and setting errors as factors in aviation safety are discussed, including problems associated with altitude-including instruments. A sample of reports from pilots and controllers is included, covering the topics of ATIS broadcasts and clearance readback problems. A selection of Alert Bulletins, with their responses, is included. S.F.

NASA CONTRACTOR REPORTS

X81-10161*# Systems Technology, Inc., Mountain View, Calif.
DEVELOPMENT OF A CTOL PILOTING TECHNIQUE MEASUREMENT SCHEME FOR A REAL TIME SIMULATOR ENVIRONMENT

Robert K. Heffley and Wayne F. Jewell Jul. 1979 54 p refs
(Contract NAS2-10120)
(NASA-CR-152294; TR-1139-1; HUD-9) Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

The approach used in a study conducted to develop a practical scheme for measuring CTOL piloting technique in a real time simulator environment consisted of performing a running least squares fit of pilot generated simulator data to a function representing an assumed form of piloting technique. To obtain variations in the pilot element, the least squares algorithm was periodically reinitialized. Valid results were demonstrated off line using existing data from simulated landing approaches involving regulation of flight director and airspeed. Changes were detectable in pilot gain and lead compensation. Also, a switch from tracking pitch attitude to tracking flight director could be inferred. The report describes the piloting technique measurement procedure and results obtained. Recommendations are given for eventual implementation in a real time simulator environment, and several improvements are suggested for enhanced results. A.R.H.

X81-10162*# Systems Technology, Inc., Mountain View, Calif.
A PILOT CONTROL STRATEGY IDENTIFICATION

TECHNIQUE FOR USE IN MULTILoop CONTROL TASKS

Wayne F. Jewell and Ted M. Schulman Aug. 1980 113 p refs

(Contract NAS2-10385)

(NASA-CR-152374; TR-1153-2)

Unclassified report

NOTICE: Available to U.S. Government Agencies and Their Contractors.

A technique for measuring a pilot's control strategy is described. The technique, called the Non-Intrusive Pilot Identification Program (NIPIP), estimates the pilot's input-output describing function and combined pilot-vehicle performance parameters such as crossover frequency, and phase margin by using a time domain model of the pilot and a least squares identification algorithm. NIPIP functions is realtime and uses a sliding time window to maintain freshness in the data; thus time-varying characteristics in the pilot's control strategy can be measured. The results of a performance evaluation of NIPIP, the results of applying NIPIP to a realtime ground-based simulation of two competing concepts of head-up displays (HUD) for use in conventional takeoff and landing are given. Differences in the pilot's control strategy used for the two HUDs and the head-down display are quantified in terms of differences in the pilot's describing functions are combined pilot-vehicle measurements. Conclusions based on the performed evaluation and application of NIPIP are presented and some recommendations on how NIPIP could be used in other manual control tasks are discussed.

M.G.

N81-17716* Forschungsinstitut fuer Anthropotechnik, Meckenheim (West Germany). Forschungsgesellschaft fuer Angewandte Naturwissenschaften e. V.

MONITORING AND DECISION MAKING BY PEOPLE IN MAN MACHINE SYSTEMS (UEBERWACHUNG- UND ENTSCHEIDUNGSVERHALTEN DES MENSCHEN IN MENSCH-MASCHINE-SYSTEMEN)

G. Johansen May 1979 92 p refs Partly in GERMAN and ENGLISH

(Grant NSG-2119)

(NASA-CR-164026; FB-44) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10 CSCL 05H

The analysis of human monitoring and decision making behavior as well as its modeling are described. Classic and optimal control theoretical, monitoring models are surveyed. The relationship between attention allocation and eye movements is discussed. As an example of applications, the evaluation of predictor displays by means of the optimal control model is explained. Fault detection involving continuous signals and decision making behavior of a human operator engaged in fault diagnosis during different operation and maintenance situations are illustrated. Computer aided decision making is considered as a queueing problem. It is shown to what extent computer aids can be based on the state of human activity as measured by psychophysiological quantities. Finally, management information systems for different application areas are mentioned. The possibilities of mathematical modeling of human behavior in complex man machine systems are also critically assessed.

Author (ESA)

N81-22031* Battelle Columbus Labs., Mountain View, Calif. A REVIEW OF IN-FLIGHT EMERGENCIES IN THE ASRS DATA BASE Final Report

Richard F. Porter 3 Apr. 1981 25 p

(Contract NAS2-10060)

(NASA-CR-166166) Avail: NTIS HC A02/MF A01 CSCL 01C

A series of 154 in-flight emergencies as reported to the Aviation Safety Reporting System are described. The various types of emergencies are examined and an attempt is made to determine the human errors and other factors associated with each incident, as well as the measures taken to resolve the emergency. It is concluded that nearly one half of those

emergencies reported were related to failure or malfunction of aircraft subsystems. Of all the emergencies, nearly one quarter were associated with power plant failure. Other frequently encountered emergency types are associated with operation in instrument meteorological conditions without appropriate clearance or qualification, and with low fuel state situations. Human error is prominently featured in many of the incidents, appearing in the actions of pilots and air traffic controllers.

E.D.K.

N81-22037* Battelle Columbus Labs., Mountain View, Calif. POTENTIAL EFFECTS OF THE INTRODUCTION OF THE DISCRETE ADDRESS BEACON SYSTEM DATA LINK ON AIR/GROUND INFORMATION TRANSFER PROBLEMS

Ralph L. Grayson 30 Mar. 1981 47 p ref

(Contract NAS2-10060)

(NASA-CR-166165) Avail: NTIS HC A03/MF A01 CSCL 17G

This study of Aviation Safety Reporting System reports suggests that benefits should accrue from implementation of discrete address beacon system data link. The phase enhanced terminal information system service is expected to provide better terminal information than present systems by improving currency and accuracy. In the exchange of air traffic control messages, discrete address insures that only the intended recipient receives and acts on a specific message. Visual displays and printer copy of messages should mitigate many of the reported problems associated with voice communications. The problems that remain unaffected include error in addressing the intended recipient and messages whose content is wrong but are otherwise correct as to format and reasonableness.

Author

N81-22696* Battelle Columbus Labs., Mountain View, Calif. FATIGUE AND ASSOCIATED PERFORMANCE DECREMENTS IN AIR TRANSPORT OPERATIONS

E. Gene Lyman and Harry W. Orlady 31 Mar. 1981 36 p refs

(Contract NAS2-10060)

(NASA-CR-166167) Avail: NTIS HC A03/MF A01 CSCL 05E

A study of safety reports was conducted to examine the hypothesis that fatigue and associated performance decrements occur in air transport operations, and that these are associated with some combination of factors: circadian desynchronization, duty time; pre-duty activity; sleep; work scheduling; workload; and environmental deprivation. The findings are based on a selected sample of reported incidents in which the reporter associated fatigue with the occurrence. In comparing the fatigue reports with a control set, significant performance decrements were found to exist related to time-of-day, awareness and attention to duty, less significantly, final phases of flights. The majority of the fatigue incidents involved such unsafe events as altitude deviations, takeoffs and landing without clearance, and the like. Considerations of duty and sleep are the major factors in the reported fatigue conditions.

S.F.

N81-27063* Battelle Columbus Labs., Ohio.

A STUDY OF ASRS REPORTS INVOLVING GENERAL AVIATION AND WEATHER ENCOUNTERS Interim Report

Thomas H. Rockwell (Ohio State Univ.), Darrell E. Roach (Ohio State Univ.), and Walter C. Griffin (Ohio State Univ.) 26 Jun. 1981 57 p

(Contract NAS2-10060)

(NASA-CR-166212) Avail: NTIS HC A04/MF A01 CSCL 01C

Consideration is given to the nature and characteristics of problems involving dissemination of weather information, use of this information by pilots, its adequacy for the purpose intended, the ability of the air traffic control system to cope with weather related incidents, and the various aspects of pilot behavior, aircraft equipment, and NAVAIDS affecting flights in which weather

figures. It is concluded from the study that skill and training deficiencies of general aviation pilots are not major factors in weather related occurrences, nor is lack of aircraft equipment. Major problem causes are identified with timely and easily interpreted weather information, judgement and attitude factors of pilots, and the functioning of the air traffic control system.

E.D.K.

N81-29108*# Battelle Columbus Labs., Ohio.
AN INVESTIGATION OF REPORTS OF CONTROLLED FLIGHT TOWARD TERRAIN (CFTT) Interim Report
Richard F. Porter and James P. Loomis 6 Apr. 1981 68 p refs
(Contract NAS2-10060)
(NASA-CR-166230) Avail: NTIS HC A04/MF A01 CSCL 01C

Some 258 reports from more than 23,000 documents in the files of the Aviation Safety Reporting System (ASRS) were found to be to the hazard of flight into terrain with no prior awareness by the crew of impending disaster. Examination of the reports indicate that human error was a causal factor in 64% of the incidents in which some threat of terrain conflict was experienced. Approximately two-thirds of the human errors were attributed to controllers, the most common discrepancy being a radar vector below the Minimum Vector Altitude (MVA). Errors by pilots were of a much diverse nature and include a few instances of gross deviations from their assigned altitudes. The ground proximity warning system and the minimum safe altitude warning equipment were the initial recovery factor in some 18 serious incidents and were apparently the sole warning in six reported instances which otherwise would most probably have ended in disaster.

A.R.H.

N81-29110*# Battelle Columbus Labs., Ohio.
ATC CONTINGENCY OPERATIONS IN THE EN-ROUTE FLIGHT REGIME Interim Report
E. Gene Lyman 15 Apr. 1981 24 p refs
(Contract NAS2-10060)
(NASA-CR-166231) Avail: NTIS HC A02/MF A01 CSCL 17G

Air traffic control (ATC) operations were examined to learn what factors of controller performance should be given consideration in the design and development of future automation systems enhancing ATC. Contingencies were of two types: those constraining airspace usage or traffic flow (i.e., weather); and those related to system and equipment usage (i.e., radar/radio status). Examination of controller response to contingencies and workload pressures showed differing effects on controller allocations of effort among the three primary function of planning, monitoring, and information transfer. Automation advancements oriented towards aiding the controller in performing monitoring tasks may offer the most substantial safety benefit.

S.F.

N81-30106*# Battelle Columbus Labs., Mountain View, Calif.
OPERATIONAL PROBLEMS EXPERIENCED BY SINGLE PILOTS IN INSTRUMENT METEOROLOGICAL CONDITIONS Interim Report
Stacy Weislogel 5 Aug. 1981 74 p refs
(Contract NAS2-10060)
(NASA-CR-166236) Avail: NTIS HC A04/MF A01 CSCL 17G

The development and implementation of a search strategy to extract pertinent reports from the Aviation Safety Reporting System-2 (ASRS-2) database are described. For any particular occurrence to be pertinent to the study, it must have satisfied the following conditions: the aircraft must be of the type usually flown by a single pilot; operation on an IFR flight plan in instrument meteorological conditions; pilot experienced an operational problem. The occurrences consist of reports by the pilot about his own performance, by the pilot about the system performance, or by an air traffic controller about a pilot's performance. T.M.

N81-31847*# Illinois Univ., Urbana. Coordinated Science Lab.

PILOT INTERACTION WITH AUTOMATED AIRBORNE DECISION MAKING SYSTEMS Final Report, Nov. 1975 - Aug. 1981

William B. Rouse Aug. 1981 28 p refs

(Grant NSG-2119)

(NASA-CR-164729; T-106) Avail: NTIS HC A03/MF A01 CSCL 05H

The role of the pilot and crew for future aircraft is discussed. Fifteen formal experimental studies and the development of a variety of models of human behavior based on queueing history, pattern recognition methods, control theory, fuzzy set theory, and artificial intelligence concepts are presented. L.F.M.

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-13419 * Evaluation of the potential format and content of a cockpit display of traffic information. S. G. Hart and L. L. Loomis (Tufts University, Medford, Mass.). *Human Factors*, vol. 22, Oct. 1980, p. 591-604. 5 refs. Grant No. NSG-2156.

The types and formats of information most suitable to be displayed in a cockpit display of traffic information (CDTI) are investigated. Twenty three airline pilots and 13 instrumented general aviation pilots were asked to select from sets of symbols of various complexities incorporating various levels of information that would contain all information necessary for monitoring the traffic situation, detecting errors, maintaining separation and merging. Display features selected by a significant number of pilots were then evaluated for their capabilities in helping pilots to assess the lateral or vertical separation between their own and another aircraft in a dynamic simulation. It is found that while some of the features initially chosen by the pilots, such as flightpath predictors, aided the pilots in perceiving the traffic situation correctly, others, such as ground speed and climb/descend arrows and relative altitude encoding of symbols for other aircraft, did not contribute to improved performance speed or accuracy. A.L.W.

A81-13420 * Perception of horizontal aircraft separation on a cockpit display of traffic information. E. A. Palmer (NASA, Ames Research Center, Man-Vehicle Systems Research Div., Moffett Field, Calif.), S. J. Jago, D. L. Baty (San Jose State University, San Jose, Calif.), and S. L. O'Connor. *Human Factors*, vol. 22, Oct. 1980, p. 605-620. 14 refs.

The influence of various display symbologies in a cockpit display of traffic information (CDTI) on pilot perception of horizontal aircraft separation is investigated. In a series of nine experiments using different combinations of display symbology, information update rate, display viewing time and encounter geometry, subjects were asked to predict whether an intruder aircraft would pass in front of or behind their own aircraft. It is found that displayed history did not improve task performance, although it was desired by the pilots when no other display of aircraft turn rate was available, and that pilots made fewer errors when they had predictive information. Variations in the rate of updating information from 0.1 to 4 sec and viewing times from 1 to 16 sec are not observed to affect performance. It is concluded that the present task, which may arise in a collision avoidance situation, would require an onboard computer to make a prediction of relative aircraft position and display it on the CDTI. A.L.W.

A81-42133 * Visual fatigue - The need for an integrated model. F. V. Malmstrom (Southern California, University, Los Angeles, CA), R. J. Randle, M. R. Murphy (NASA, Ames Research

Center, Moffett Field, CA), L. E. Reed (USAF, Human Resources Laboratory, Wright-Patterson AFB, OH), and R. J. Weber (Oklahoma State University, Stillwater, OK). *Psychonomic Society, Bulletin*, vol. 17, no. 4, 1981, p. 183-186. 20 refs. NASA-USAF-supported research.

Two experiments were conducted to examine possible decrements in performance over time on two visual tracking tasks. In Experiment 1, six subjects tracked a horizontal, sinusoidally moving target in the picture plane for 6.5 min. In Experiment 2, six subjects tracked a target sinusoidally changing focus in the depth plane between 0 and 4 D over 6.5 min. Results indicated a linearly decreasing amplitude of both pursuit eye movements (.29 deg of visual angle per minute) and accommodation (.11 D/min). These visual fatigue effects are discussed in the context of several competing explanations. (Author)

CONFERENCE AND MEETING PAPERS

N81-17074* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN ADVANCED ELECTRONIC COCKPIT INSTRUMENTATION SYSTEM: THE COORDINATED COCKPIT DISPLAY
D. L. Baty and M. L. Watkins / In AGARD Advan. on Visualization Tech. Oct. 1980 11 p refs Prepared in cooperation with San Jose State University Foundation, Calif. (For primary document see N81-17063 08-06)

Avail: NTIS HC A10/MF A01 CSCL 01D

Cathode ray tube (CRT) and computer technologies have reached the stage where current flight and engine instruments can economically be replaced by computer controlled CRT displays. This provides a tremendous opportunity for flexibility to the cockpit display designer, but the use of this flexibility should stay within the realities of the flight environment. One approach to the replacement of flight instruments is described, using three separate color CRT's. Each CRT displays information pertinent to one of the three orthogonal projections of the aircraft flight situation. Three airline pilots made a preliminary assessment of this display set. Comments, rankings, and ratings show that, in general, the pilots accepted the concept of pictorial flight displays. E.D.K.

N81-19044* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN EVALUATION OF HEAD-UP DISPLAYS IN CIVIL TRANSPORT OPERATIONS

John K. Lauber, Richard S. Bray, and Barry C. Scott (FAA) / In NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 197-199 refs (For primary document see N81-19035 10-03)

Avail: NTIS HC A17/MF A01 CSCL 01C

To determine the advantages and disadvantages of head-up displays (HUD) in civil transport approach and landing operations, an operational evaluation was conducted on the flight simulator for advanced aircraft at Ames. A non-conformal HUD concept which contained raw data and Flight Director command information, and a conformal, flight path HUD concept was designed to permit terminal area maneuvering, intercept, final approach, flare, and landing operations. Twelve B-727 line pilots (Captains) flew a series of precision and non-precision approaches under a variety of environmental and operational conditions, including wind shear, turbulence and low ceilings and visibilities. A preliminary comparison of various system and pilot performance measures as a function of display type (Flight Director HUD, Flight Path HUD, or No HUD) indicates improvements in precision and accuracy of aircraft flight path control when using the HUDs. The results also demonstrated some potentially unique advantages of a flight path HUD during non-precision approaches. A.R.H.

N81-19046* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

APPLICATION OF THE EPIDEMIOLOGICAL MODEL IN STUDYING HUMAN ERROR IN AVIATION

Ed S. Cheaney (Battelle Columbus Labs., Mountain View, Calif.) and Charles E. Billings / In NASA. Langley Research Center The 1980 Aircraft Safety and Operating Probl., Pt. 1 Mar. 1981 p 219-236 refs (For primary document see N81-19035 10-03)
Avail: NTIS HC A17/MF A01 CSCL 01C

An epidemiological model is described in conjunction with the analytical process through which aviation occurrence reports are composed into the events and factors pertinent to it. The model represents a process in which disease, emanating from environmental conditions, manifests itself in symptoms that may lead to fatal illness, recoverable illness, or no illness depending on individual circumstances of patient vulnerability, preventive actions, and intervention. In the aviation system the analogy of the disease process is the predilection for error of human participants. This arises from factors in the operating or physical environment and results in errors of commission or omission that, again depending on the individual circumstances, may lead to accidents, system perturbations, or harmless corrections. A discussion of the previous investigations, each of which manifests the application of the epidemiological method, exemplifies its use and effectiveness. M.G.

A81-20467* Human factors by descent energy management. R. E. Curry (NASA, Ames Research Center, Aviation Safety Research Office, Moffett Field, Calif.). In: Conference on Decision and Control, and Symposium on Adaptive Processes, 18th, Fort Lauderdale, Fla., December 12-14, 1979, Proceedings. Volume 1. (A81-20426 07-63) Piscataway, N.J., Institute of Electrical and Electronics Engineers, Inc., 1979, p. 422-426. 5 refs.

This paper describes some of the results of a human factors study of energy management during descent using standard aircraft displays. Discussions with pilots highlighted the practical constraints involved and the techniques (algorithms) used to accomplish the descent. The advantages and disadvantages of these algorithms are examined with respect to workload and their sensitivity to disturbances. Vertical navigation and flight performance computers are discussed in terms of the information needed for effective pilot monitoring and takeover. (Author)

A81-36569* Low-visibility visual simulation with real fog. W. D. Chase (NASA, Ames Research Center, Moffett Field, Calif.). In: Flight Simulation Technologies Conference, Long Beach, Calif., June 16-18, 1981, Technical Papers. (A81-36554 16-09) New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 116-128. 17 refs. (AIAA 81-0982)

An environmental fog simulation (EFS) attachment was developed to aid in the study of natural low-visibility visual cues and subsequently used to examine the realism effect upon the aircraft simulator visual scene. A review of the basic fog equations indicated that two major factors must be accounted for in the simulation of low visibility - one due to atmospheric attenuation and one due to veiling luminance. These factors are compared systematically by (1) comparing actual measurements to those computed from the fog equations, and (2) comparing runway-visual-range-related visual-scene contrast values with the calculated values. These values are also compared with the simulated equivalent equations and with contrast measurements obtained from a current electronic fog synthesizer to help identify areas in which improvements are needed. These differences in technique, the measured values, the features of both systems, a pilot opinion survey of the EFS fog, and improvements (by combining features of both systems) that are expected to significantly increase the potential as well as flexibility for producing a very high-fidelity low-visibility visual simulation are discussed. (Author)

OFFICE OF THE DIRECTOR OF RESEARCH SUPPORT

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-15891 * # Acoustic resonances and sound scattering by a shear layer. S. P. Koutsoyannis, K. Karamcheti (Stanford University, Stanford, Calif.), and D. C. Galant (NASA, Ames Research Center, Moffett Field, Calif.). (*American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 5th, Seattle, Wash., Mar. 12-14, 1979, Paper 79-0627.*) *AIAA Journal*, vol. 18, Dec. 1980, p. 1446-1454. 24 refs. Grants No. NsG-2007; No. NsG-676.

The reflection and transmission characteristics of plane waves scattered by a finite-thickness shear layer having a linear velocity profile and bounded by two otherwise uniform parallel flows is examined using the pressure perturbation equation solutions in the shear layer shown previously to be in terms of Whittaker M functions. In addition to the angle of plane wave incidence and the relative Mach number of the flows bounding the shear layer, it is found that the scattering properties of the shear layer depend crucially upon a parameter, τ in such a manner that the case τ approaching zero characterizes the long wavelength properties of the layer and the case τ approaching infinity characterizes the short wavelength properties of the layer. In contrast to the region of ordinary reflection in the cases where the corresponding vortex sheet does not have a Brewster angle, the values of the reflection coefficient up to τ of 2 follow those of the vortex sheet; for the case for which the corresponding vortex sheet has a Brewster angle,

the magnitude of the reflection coefficient may be sensitive to even small changes in τ in certain cases. (Author)

CONFERENCE AND MEETING PAPERS

A81-18701 * # A symmetric modal formulation of fluid-structure interaction, including a static approximation to higher order fluid modes. R. H. MacNeal (MacNeal-Schwendler Corp., Los Angeles, Calif.), R. Citerley (Anamet Laboratories, Inc., San Carlos, Calif.), and M. Chargin (NASA, Ames Research Center, Moffett Field, Calif.). *American Society of Mechanical Engineers, Century 2 Pressure Vessels and Piping Conference, San Francisco, Calif., Aug. 12-15, 1980, Paper 80-C2/PVP-116.* 13 p. 21 refs. Members, \$1.50; nonmembers, \$3.00.

A method of fluid-structure coupling which provides symmetrical matrix equations of standard form solved by existing finite element computer programs is presented. The method postulates that the uncoupled vibration modes of the fluid or the structure be calculated before the coupled analysis. A numerical solution of vibration modes in an axisymmetric container demonstrated that a static approximation to higher order fluid modes can improve the accuracy of dynamic response computations using modal methods. A.T.

RESEARCH FACILITIES AND INSTRUMENTATION DIVISION

NASA TECHNICAL MEMORANDA

N81-23434* # National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A SOLID-STATE DIGITAL TEMPERATURE RECORDER FOR SPACE USE

Richard M. Westbrook, Lawrence D. Bennett, Robert A. Steinhaver, and Gordon J. Deboo Apr. 1981 75 p
(NASA-TM-81267; A-8482) Avail: NTIS HC A04/MF A01 CSCL 14C

A solid-state, digital, temperature recorder has been developed for use in space experiments. The recorder is completely self-contained and includes a temperature sensor; all necessary electronics for signal conditioning, processing, storing, control and timing; and a battery power supply. No electrical interfacing with the particular spacecraft on which the unit is used is required. The recorder is small, light, and sturdy, and has no moving parts. It uses only biocompatible materials and has passed vibration and shock spaceflight qualification tests. The unit is capable of storing 2048, -10 to +45 C, 8-bit temperature measurements taken at intervals selectable by factors of 2 from 1.875 to 240 min; data can be retained for at least 6 months. The basic recorder can be simplified to accommodate a variety of applications by adding memory to allow more data to be recorded, by changing the front end to permit measurements other than temperature to be made, and by using different batteries

to realize various operating periods. Stored flight data are read out from the recorder by means of a ground read-out unit.

Author

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-47639 * # Fiber optics transmission of LV signal. A. D. Young and W. D. Gunter, Jr. (NASA, Ames Research Center, Research Facilities and Instrumentation Div., Moffett Field, CA). *Applied Optics*, vol. 20, Sept. 15, 1981, p. 3096, 3097.

The first use of a long optical fiber for transmitting megahertz frequencies in a laser velocimeter (LV) receiver system is reported. The fiber comprises a 600-micron diameter fused silica core, a silicon polymer cladding and a plastic jacket. The fiber numerical aperture is 0.22, corresponding to a maximum entrance half-angle of 0.22 rad. The 10-m length used results in a 5.6% attenuation loss. The fiber is found to transmit an 80-MHz signal with excellent resolution. It is established that an LV receiver using fiber optics sends a clean signal in electronically noisy and high-pressure environments and allows velocity measurements in places too small for a photomultiplier tube. C.R.

TECHNICAL SERVICES DIVISION

PATENTS

N81-14805* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

MICRO-FLUID EXCHANGE COUPLING APPARATUS
Patent

John E. Johnson, Jr. (San Francisco Univ.) and Paul F. Swartz,
inventors (to NASA) Issued 15 Jul. 1980 6 p Filed 16 Oct.
1978 Supersedes N78-33717 (16 - 24, p 3257)

(NASA-Case-ARC-11114-1; US-Patent-4,212,297;

US-Patent-Appl-SN-951422; US-Patent-Class-128-207.14;

US-Patent-Class-128-204.18; US-Patent-Class-128-207.28;

US-Patent-Class-128-DIG.26; US-Patent-Class-128-236;

US-Patent-Class-128-DIG.6; US-Patent-Class-128-DIG.9;

US-Patent-Class-128-DIG.12; US-Patent-Class-128-DIG.16)
Avail: US Patent and Trademark Office CSCL 06B

In a macro-fluid exchange, a hollow needle, such as a syringe needle, is provided for penetrating the fluid conduit of the animal. The syringe needle is coupled to a plenum chamber having an inlet and outlet port. The plenum chamber is coupled to the syringe needle via the intermediary of a standard quick disconnect coupling fitting. The plenum chamber is carried at the end of a drive rod which is coupled to a micrometer drive head. The micrometer drive head is slidably and pivotably coupled to a pedestal for adjusting the height and angle of inclination of the needle relative to a reference base support. The needle is positioned adjacent to the incised trachea or a blood vessel of a small animal and the micrometer drive head is operated for penetrating the fluid conduit of the animal.

Official Gazette of the U.S. Patent and Trademark Office

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AIR FORCE FLIGHT DYNAMICS LABORATORY OFFICE

CONFERENCE AND MEETING PAPERS

A81-20761 * # Flight experiments with a slender cone at angle of attack. D. J. Peake (3-D Flowz, Inc., Moffett Field, Calif.), D. F. Fisher (NASA, Flight Research Center, Edwards AFB, Calif.), and D. S. McRae (USAF, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St. Louis, Mo., Jan. 12-15, 1981, Paper 81-0337*. 23 p. 17 refs. Contract No. NAS2-10578.

The three-dimensional leeward separation about a 5 deg semi-angle cone at an 11 deg angle of attack was investigated in flight, in the wind tunnel, and by numerical computations. The test conditions were Mach numbers of 0.6, 1.5, and 1.8 at Reynolds numbers between 7 and 10 million based on free-stream conditions and a 30-inch wetted length or surface. The surface conditions measured included mean static and fluctuating pressures; skin friction magnitudes and separation line positions were obtained using obstacle blocks. The mean static pressures from flight and wind tunnel were in good agreement. The computed results gave the same distributions, but were slightly more positive in magnitude. The experimentally measured primary and secondary separation line locations compared closely with computed results. There were substantial differences in level and in trend between the surface root-mean-square pressure fluctuations obtained in flight and in the wind tunnel, due, it is thought, to a relatively high acoustic disturbance level in the tunnel compared with the quiescent conditions in flight.

(Author)

A81-21200 * Supersonic viscous flow over cones at incidence. D. S. McRae (USAF, Flight Dynamics Laboratory, Moffett Field, Calif.) and M. Y. Hussaini (NASA, Ames Research Center, Moffett Field, Calif.). In: *International Conference on Numerical Methods in Fluid Dynamics*, 6th, Tiflis, Georgian SSR, June 21-24, 1978, Proceedings. (A81-21169 07-02) Berlin, Springer-Verlag, 1979, p. 385-392. 11 refs.

The conically symmetric Navier-Stokes equations are solved by MacCormack's method for the supersonic flow past sharp cones at incidence. To provide closure for the case of turbulent flows, a scalar eddy-viscosity model based on mixing length hypotheses is used. The results are compared with available experimental data.

(Author)

A81-37557 * # The nonlinear modified equation approach to analyzing finite difference schemes. G. H. Klopfer (Nielsen Engineering and Research, Inc., Mountain View, Calif.) and D. S. McRae (NASA, Ames Research Center, Moffett Field, Calif.; USAF, Flight Vehicle Technology Office, Wright-Patterson AFB, Ohio). In: *Computational Fluid Dynamics Conference*, 5th, Palo Alto, Calif., June 22, 23, 1981, Collection of Technical Papers. (A81-37526 16-34) New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 317-332. 14 refs. Contract No. F49620-79-C-0054. (AIAA 81-1029)

The nonlinear modified equation approach is taken in this paper to analyze the generalized Lax-Wendroff explicit scheme approximation to the unsteady one- and two-dimensional equations of gas dynamics. Three important applications of the method are demonstrated. The nonlinear modified equation analysis is used to (1) generate higher order accurate schemes, (2) obtain more accurate estimates of the discretization error for nonlinear systems of partial differential equations, and (3) generate an adaptive mesh procedure for the unsteady gas dynamic equations. Results are obtained for all three areas. For the adaptive mesh procedure, mesh point requirements for equal resolution of discontinuities were reduced by a factor of five for a 1-D shock tube problem solved by the explicit MacCormack scheme.

(Author)

A81-39014 * # Computation of hypersonic viscous flow around three-dimensional bodies at high angles of attack. Y. M. Rizk, D. S. Chaussee, and D. S. McRae (NASA, Ames Research Center, Moffett Field, CA). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference*, 14th, Palo Alto, CA, June 23-25, 1981, Paper 81-1261. 18 p. 21 refs.

A parabolized Navier-Stokes code capable of predicting steady viscous supersonic flows with cross-flow separation is applied to three-dimensional arbitrary geometries at high angles of attack. The numerical procedure, which is implicit, noniterative, and of second-order accuracy in the marching direction, has been used to compute complicated flow fields containing a relatively thick sonic layer and regions of strong viscous-inviscid interaction. A consistent and accurate procedure has also been developed to provide the necessary starting data through timewise integration of the equations of motion near the nose-tip region of the body. Numerical results obtained from the present method compare well with experiment for both the surface pressures and heat transfer.

(Author)

ARMY RESEARCH AND TECHNOLOGY LABORATORIES (AVRADCOM)

NASA TECHNICAL MEMORANDA

N81-12018*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

A CONSERVATIVE IMPLICIT FINITE DIFFERENCE ALGORITHM FOR THE UNSTEADY TRANSONIC FULL POTENTIAL EQUATION

Joseph L. Steger (Flow Simulations, Inc., Sunnyvale, Calif.) and Francis X. Caradonna (Army Aviation Research and Development Command, St. Louis, Mo.) Oct. 1980 40 p refs
(Contract NAS2-10417)

(NASA-TM-81211; AVRADCOM-TR-80-A-14) Avail: NTIS HC A03/MF A01 CSCL 01A

An implicit finite difference procedure is developed to solve the unsteady full potential equation in conservation law form. Computational efficiency is maintained by use of approximate factorization techniques. The numerical algorithm is first order in time and second order in space. A circulation model and difference equations are developed for lifting airfoils in unsteady flow; however, thin airfoil body boundary conditions have been used with stretching functions to simplify the development of the numerical algorithm. Author

N81-18295*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

US ARMY REMOTELY PILOTED VEHICLE SUPPORTING TECHNOLOGY PROGRAM

Terrence D. Gossert Jan. 1981 13 p refs

(NASA-TM-81263; A-8450; USAAVRADCOM-TR-81-A-3) Avail: NTIS HC A02/MF A01 CSCL 01C

Essential technology programs that lead to the full scale engineering development of the Aquila Remotely Piloted Vehicle system for U.S. Army are described. The Aquila system uses a small recoverable and reusable RPV to provide target acquisition, designation, and aerial reconnaissance mission support for artillery and smart munitions. Developments that will provide growth capabilities to the Aquila RPV system, as well as future RPV mission concepts being considered by the U.S. Army are presented. Author

N81-26487*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

LOGIC ANALYSIS OF COMPLEX SYSTEMS BY CHARACTERIZING FAILURE PHENOMENA TO ACHIEVE DIAGNOSIS AND FAULT-ISOLATION

James T. Wong and William L. Andre Apr. 1981 22 p refs
Presented at the Joint Intern. Meeting of CORS and ORSA, Toronto, 3-6 May 1981 Prepared in cooperation with Army Research and Technology Labs., Moffett Field, Calif.
(NASA-TM-81291; USAAVRADCOM-TR-81-A-12; A-8561)
Avail: NTIS HC A02/MF A01 CSCL 14D

A recent result shows that, for a certain class of systems, the interdependency among the elements of such a system together with the elements constitutes a mathematical structure a partially ordered set. It is called a loop free logic model of the system. On the basis of an intrinsic property of the mathematical structure, a characterization of system component failure in terms of maximal subsets of bad test signals of the system was obtained. Also, as a consequence, information concerning the total number of failure components in the system was deduced. Detailed examples are given to show how to restructure real systems containing loops into loop free models for which the result is applicable. Author

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AEROMECHANICS LABORATORY

NASA TECHNICAL MEMORANDA

N81-11012*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TRANSONIC ROTOR NOISE: THEORETICAL AND EXPERIMENTAL COMPARISONS

F. H. Schmitz and Y. H. Yu Nov. 1980 31 p refs
(NASA-TM-81236; A-8342; AVRADCOM-TR-80-A-12) Avail: NTIS HC A03/MF A01 CSCL 01A

Two complementary methods of describing the high speed rotor noise problem are discussed. The first method uses the second order transonic potential equation to define and characterize the nature of the aerodynamic and acoustic fields and to explain the appearance of radiating shock waves. The second employs the Ffowcs Williams and Hawkings equation to successfully calculate the acoustic far field. Good agreement between theoretical and experimental waveforms is shown for transonic hover tip Mach numbers from 0.8 to 0.9. Author

N81-19101*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE ROLE OF THE RESEARCH SIMULATOR IN THE SYSTEMS DEVELOPMENT OF ROTORCRAFT

Irving C. Statler and Arlin Deel Mar. 1981 25 p refs Prepared in cooperation with Army Aviation and Development Command, Moffett Field, Calif.

(NASA-TM-81276; USAAVRADCOM-TR-81-A-7) Avail: NTIS HC A02/MF A01 CSCL 01C

The potential application of the research simulator to future rotorcraft systems design, development, product improvement evaluations, and safety analysis is examined. Current simulation capabilities for fixed-wing aircraft are reviewed and the requirements of a rotorcraft simulator are defined. The visual system components, vertical motion simulator, cab, and computation system for a research simulator under development are described. M.G.

NASA CONTRACTOR REPORTS

N81-26116*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.

FLAP-LAG-TORSIONAL DYNAMIC MODELLING OF ROTOR BLADES IN HOVER AND IN FORWARD FLIGHT, INCLUDING THE EFFECT OF CUBIC NONLINEARITIES

M. R. M. CrespoDaSilva Jul. 1981 73 p refs
(Grant NAG2-38)

(NASA-CR-166194; ASD-81-6-1) Avail: NTIS HC A04/MF A01 CSCL 01C

The differential equations of motion, and boundary conditions, describing the flap-lead/lag-torsional motion of a flexible rotor blade with a precone angle and a variable pitch angle, which incorporates a pretwist, are derived via Hamilton's principle. The meaning of inextensionality is discussed. The equations are reduced to a set of three integro partial differential equations by elimination of the extension variable. The generalized aerodynamic forces are modelled using Greenberg's extension of Theodorsen's strip theory. The equations of motion are systematically expanded into polynomial nonlinearities with the objective of retaining all terms up to third degree. The blade is modeled as a long, slender, of isotropic Hookean materials. Offsets from the blade's elastic axis through its shear center and the

axes for the mass, area and aerodynamic centers, radial nonuniformities of the blade's stiffnesses and cross section properties are considered and the effect of warp of the cross section is included in the formulation. E.A.K.

N81-26117*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.

FLAG-LAG-TORSIONAL DYNAMICS OF EXTENSIONAL AND INEXTENSIONAL ROTOR BLADES IN HOVER AND IN FORWARD FLIGHT Semiannual Progress Report, Jan. - Jun. 1981

M. R. M. CrespoDaSilva Jun. 1981 3 p refs

(Grant NAG2-38)

(NASA-CR-164475) Avail: NTIS HC A02/MF A01 CSCL 01C

The formulation of differential equations of motion for both extensional and inextensional rotor blades, and the effect of cubic nonlinearities was examined. The developed differential equations are reduced to a set of three integro partial differential equations for a hingeless blade by eliminating the extension variable. Aerodynamic forces are modelled using Greenberg's extension of Theodorsen's strip theory. Equations of motion are expanded into polynomial nonlinearities to evaluate the motion of the system. E.A.K.

N81-23433*# Stanford Univ., Calif. Dept. of Aeronautics and Acoustics.

APPLICATION OF HOLOGRAPHY TO THE STUDY OF HELICOPTER ROTOR FLOW FIELDS Semiannual Progress Report, 1 Jul. - 31 Dec. 1980

Donald Baganoff 29 May 1981 37 p refs

(Grant NAG2-45)

(NASA-CR-164293) Avail: NTIS HC A03/MF A01 CSCL 20F

The feasibility of an experiment which is intended to measure the density field about a model helicopter rotor using holographic interferometry is considered. The numerical simulation used to study the experiment is described as well as the measurement technique itself. Data generated by the simulation are presented and prospects for both determining the density field from these data, and for actually obtaining such data in practice are assessed. A few significant problems which may be expected to arise are indicated and discussed. Author

CONFERENCE AND MEETING PAPERS

N81-12824# Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.

TRANSONIC ROTOR NOISE - THEORETICAL AND EXPERIMENTAL COMPARISONS

F. H. Schmitz and Y. H. Yu 1980 29 p refs Presented at the 6th European Rotorcraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980

(AD-A090806; Rept-22) Avail: NTIS HC A03/MF A01 CSCL 20/1

Two complementary methods of describing the high-speed rotor noise problem are discussed. The first method uses the second-order transonic potential equation to define and characterize the nature of the aerodynamic and acoustic fields and to explain the appearance of radiating shock waves. The second

employs the Flowcs Williams and Hawkings equation to successfully calculate the acoustic far-field. Good agreement between theoretical and experimental waveforms is shown for transonic hover tip Mach numbers from 0.8 to 0.9. GRA

N81-33146# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE ROLE OF THE RESEARCH SIMULATOR IN THE SYSTEMS DEVELOPMENT OF ROTORCRAFT c09
 Irving C. Statler and Arlin Deel / In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 21 p refs Prepared in cooperation with Army Aviation Research

and Development Command, Moffett Field, Calif. (For primary document see N81-33137 24-01)
 Avail: NTIS HC A12/MF A01 CSCL 14B

Over the last 20 years, flight simulators became widely accepted as training tools. Moreover, research simulators were used extensively by the fixed-wing industry: in the design, testing, and certification of new aircraft. The rotorcraft industry, however, was slow to use man-in-the-loop simulation to solve its design problems, primarily because of the difficulty of modeling complex rotorcraft for realtime simulation and because of the need for a wide-angle visual system for low-level flight. A joint U.S. Army and NASA program was initiated to provide this simulation capability for exploitation by both government and industry. The potential application of the research simulator to future rotorcraft systems design, development, product improvement evaluations, and safety analysis is discussed. T.M.

FLUID MECHANICS DIVISION

NASA TECHNICAL MEMORANDA

N81-20029*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE PHENOMENON OF DYNAMIC STALL
 W. J. McCroskey Mar. 1981 33 p refs Prepared in cooperation with Army Research and Technology Labs., Moffett Field, Calif. (NASA-TM-81264; A-8464) Avail: NTIS HC A03/MF A01 CSCL 01A

The general features of dynamic stall on oscillating airfoils are explained in terms of the vortex shedding phenomenon, and the important differences between static stall, light dynamic stall, and deep stall are described. An overview of experimentation and prediction techniques is given. M.G.

N81-20384*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTATION OF UNSTEADY TURBULENT BOUNDARY LAYERS WITH FLOW REVERSAL AND EVALUATION OF TWO SEPARATE TURBULENCE MODELS
 Tuncer Cebeci and Lawrence W. Carr Mar. 1981 61 p refs Prepared in cooperation with Army Aviation Research and Development Command, Moffett Field, Calif. (NASA-TM-81259; A-8438) Avail: NTIS HC A04/MF A01 CSCL 20D

A procedure which solves the governing boundary layer equations within Keller's box method was developed for calculating unsteady laminar flows with flow reversal. This method is extended to turbulent boundary layers with flow reversal. Test cases are used to investigate the proposition that unsteady turbulent boundary layers also remain free of singularities. Turbulent flow calculations are performed. The governing equations for both models are solved. As in laminar flows, the unsteady turbulent boundary layers are free from singularities, but there is a clear indication of rapid thickening of the boundary layer with increasing flow reversal. Predictions of both turbulence models are the same for all practical purposes. S.F.

N81-28391*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PREDICTION OF BOUNDARY-LAYER CHARACTERISTICS OF AN OSCILLATING AIRFOIL
 Tuncer Cebeci (Calif. State Univ. at Long Beach) and Lawrence W. Carr Jul. 1981 17 p refs
 (NASA-TM-81303; A-8639; USAVRADCOM-TR-81-B-18)
 Avail: NTIS HC A02/MF A01 CSCL 20D
 The evolution of unsteady boundary layers on oscillating airfoils is investigated by solving the governing equations by the

Characteristic Box scheme. The difficulties associated with computing the first profile on a given time line, and the velocity profiles with partial flow reversal are solved. A sample calculation is performed for an external velocity distribution typical of those found near the leading edge of thin airfoils. The viability of the calculation procedure is demonstrated. Author

N81-28392*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DYNAMIC BEHAVIOR OF AN UNSTEADY TURBULENT BOUNDARY LAYER
 P. G. Parikh, W. C. Reynolds, R. Jayaramen, and L. W. Carr Jul. 1981 14 p refs Prepared in cooperation with Stanford Univ., Calif.
 (NASA-TM-81304; A-8640; USAVRADCOM-TR-81-B-17; Rept-992-21-01) Avail: NTIS HC A02/MF A01 CSCL 20D

Experiments on an unsteady turbulent boundary layer are reported in which the upstream portion of the flow is steady (in the mean) and in the downstream region, the boundary layer sees a linearly decreasing free stream velocity. This velocity gradient oscillates in time, at frequencies ranging from zero to approximately the bursting frequency. For the small amplitude, the mean velocity and mean turbulence intensity profiles are unaffected by the oscillations. The amplitude of the periodic velocity component, although as much as 70% greater than that in the free stream for very low frequencies, becomes equal to that in the free stream at higher frequencies. At high frequencies, both the boundary layer thickness and the Reynolds stress distribution across the boundary layer become frozen. The behavior at higher amplitude is quite similar. At sufficiently high frequencies, the boundary layer thickness remains frozen at the mean value over the oscillation cycle, even though flow reverses near the wall during a part of the cycle. A.R.H.

N81-29382*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A REVIEW OF UNSTEADY TURBULENT BOUNDARY-LAYER EXPERIMENTS
 Lawrence W. Carr Jun. 1981 40 p refs Presented at IUTAM Symp. on Unsteady Turbulent Shear Flows, Toulouse, 5-8 May 1981 Prepared in cooperation with Army Aviation, Moffett Field, Calif.
 (NASA-TM-81297; A-8595; USAVRADCOM-TR-81-A-13)
 Avail: NTIS HC A03/MF A01 CSCL 20D

The essential results of a comprehensive review of existing unsteady turbulent boundary-layer experiments are presented. Different types of unsteady flow facilities are described, and the related unsteady turbulent boundary-layer experiments are cataloged and discussed. The measurements that were obtained in the various experiments are described, and a complete list of experimental results is presented. All the experiments that

measured instantaneous values of velocity, turbulence intensity, or turbulent shear stress are identified, and the availability of digital data is indicated. The results of the experiments are analyzed, and several significant trends are identified. An assessment of the available data is presented, delineating gaps in the existing data, and indicating where new or extended information is needed. Guidelines for future experiments are included. Author

N81-33167*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PREDICTION OF BLADE-VORTEX INTERACTION NOISE FROM MEASURED BLADE PRESSURE

Yoshiya Nakamura Sep. 1981 22 p refs Presented at 7th European Rotorcraft and Powered Lift Aircraft Forum Prepared in cooperation with Army Aviation Research and Development Command, Moffett Field, Calif.

(NASA-TM-81320; A-8692; USAVRADCOM-TR-81-A-24;

Paper-32) Avail: NTIS HC A02/MF A01 CSCL 01A

The impulsive nature of noise due to the interaction of a rotor blade with a tip vortex is studied. The time signature of this noise is calculated theoretically based on the measured blade surface pressure fluctuation of an operational load survey rotor in slow descending flight and is compared with the simultaneous microphone measurement. Particularly, the physical understanding of the characteristic features of a waveform is extensively studied in order to understand the generating mechanism and to identify the important parameters. The interaction trajectory of a tip vortex on an acoustic platform is shown to be a very important parameter for the impulsive shape of the noise. The unsteady nature of the pressure distribution at the very leading edge is also important to the pulse shape. The theoretical model using noncompact liner acoustics predicts the general shape of interaction impulse pretty well except for peak amplitude which requires more continuous information along the span at the leading edge.

Author

JOURNAL ARTICLES, BOOKS AND CHAPTERS OF BOOKS

A81-35647 * The challenge of unsteady separating flows. W. J. McCroskey (NASA, Ames Research Center; U.S. Army, Moffett Field, Calif.). *American Society of Civil Engineers, Engineering Mechanics Division, Journal*, vol. 107, June 1981, p. 547-563. 30 refs.

It is noted that the general fluid dynamic problem of unsteady separation at most practical Reynolds numbers remains an unsolved one and that no completely reliable prediction techniques exist at the present time. The modern design engineer must therefore draw from a combination of approximate theories, empirical correlations of data, and finite difference programs based on uncertain physical modeling of turbulence. An attempt is made to describe the basic features of several representative classes of problems for which unsteady effects produce strong or unusual changes in the separation characteristics of the flow. The analysis concerns itself largely with external flow, and emphasis is placed on the physical phenomena involved. C.R.

CONFERENCE AND MEETING PAPERS

N81-11033# Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.

EXPERIMENTAL AND ANALYTICAL STUDIES OF A MODEL HELICOPTER ROTOR IN HOVER

F. X. Caradonna and C. Tung 1980 20 p refs Presented at the European Rotorcraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980

(AD-A089780; Rept-25) Avail: NTIS HC A02/MF A01 CSCL 20/4

The present study is a benchmark test to aid the development of various rotor performance codes. The study involves simultaneous blade pressure measurements and tip vortex surveys. Measurements were made for a wide range of tip Mach numbers including the transonic flow regime. The measured tip vortex strength and geometry permit effective blade loading predictions when used as input to a prescribed wake lifting surface code. It is also shown that with proper inflow and boundary layer modeling, the supercritical flow regime can be accurately predicted. GRA

ROTORCRAFT DYNAMICS DIVISION

CONFERENCE AND MEETING PAPERS

N81-12071# Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.

STABILITY OF NONUNIFORM ROTOR BLADES IN HOVER USING A MIXED FORMULATION

Wendell B. Stephens, Dewey H. Hodges, John H. Avila (Technology Development of California, Santa Clara), and Ru-Mei Kung (Technology Development of California, Santa Clara) 1980 20 p refs Presented at the 6th European Rotorcraft and Powered Lift Aircraft Forum, Bristol, England, 16-19 Sep. 1980

(AD-A090756) Avail: NTIS HC A02/MF A01 CSCL 01/3

A mixed formulation for calculating static equilibrium and stability eigenvalues of nonuniform rotor blades in hover is presented. The static equilibrium equations are nonlinear and are solved by an accurate and efficient collocation method. The linearized perturbation equations are solved by a one step, second-order integration scheme. The numerical results correlate very well with published results from a nearly identical stability analysis based on a displacement formulation. Slight differences in the results are traced to terms in the equations that relate moments to derivatives of rotations. With the present ordering scheme, in which terms of the order of squares of rotations are neglected with respect to unity, it is not possible to achieve

completely equivalent models based on mixed and displacement formulations. A study of the one step methods reveals that a second order Taylor expansion is necessary to achieve good convergence for nonuniform rotating blades. Numerical results for a hypothetical nonuniform blade, including the nonlinear static equilibrium solution, were obtained with no more effort or computer time than that required for a uniform blade with the present analysis. GRA

A81-29505 # Application on the moving-block analysis. W. G. Bousman and D. J. Winkler (U.S. Army, Aeromechanics Laboratory, Moffett Field, Calif.). In: Structures, Structural Dynamics and Materials Conference, 22nd, Atlanta, Ga., April 6-8, 1981, and AIAA Dynamics Specialists Conference, Atlanta, Ga., April 9, 10, 1981, Technical Papers, Part 2. (A81-29428 12-01) New York, American Institute of Aeronautics and Astronautics, Inc., 1981, p. 755-763. 6 refs. (AIAA 81-0653)

The moving-block analysis is a digital method of analyzing transient signals to determine modal damping and frequency. Its implementation is discussed and methods to increase the accuracy of the frequency estimate and to speed the calculation of the

moving-block function are described. Computer-generated data are used to examine the capability of the method to analyze modes closely spaced in frequency. It is shown that accuracy is constrained at both small and large block sizes, and that the best results are achieved with a block size $1/4$ to $1/2$ of the signal length. The method's performance can be improved by using increased signal length or Hanning of the data; however, the computational burden will be increased in either case. A special case of the problem of two closely spaced modes is treated where one acts as a forced-response contaminant. In this case the method's accuracy is dramatically increased by selection of the block size to correctly locate the contaminant frequency's side lobes. A short discussion of the effects that actual data will have on the major results of the study is included.

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