

**ICAS** PROCEEDINGS  
1988

16th Congress of the International  
Council of the Aeronautical Sciences



Jerusalem, Israel  
August 28-September 2, 1988

Volume 1

TABLE OF CONTENTS

**VOLUME 1**

**PREFACE**

B LASCHKA ..... XXVI

**IN MEMORIAM** ..... XXXII

Frank L WATTENDORF 1906 - 1986

Hendricus J VAN DER MAAS 1900 - 1987

**ICAS-VON-KARMAN LECTURE**

**ICAS-88-0.5** The International Vortex Flow Experiment for  
Computer Code Validation  
G DROUGGE ..... XXXV

**THE DANIEL AND FLORENCE GUGGENHEIM MEMORIAL LECTURE**

**ICAS-88-0.1** The Outlook for Wind-Tunnel Testing  
W R SEARS ..... not available

**GENERAL LECTURES**

**ICAS-88-0.2** Flight Systems - Man/Machine Interface in the  
Computer Age  
S J MERHAV ..... not available

**ICAS-88-0.3** Part I: Technologies for Future Transport  
Aircraft  
M J ROEDER ..... not available

Part II: Technology of the A320 Aircraft  
J P POTOCKI ..... not available

**ICAS-88-0.4** Emerging Hypersonic Propulsion Technology  
E T CURRAN, H L BEACH ..... XLII

**ICAS-88-0.6** NASA/Industry Advanced Turboprop Technology  
Program  
J A ZIEMIANSKI, J B WHITLOW Jr ..... LIV

## **ENVIRONMENTAL SAFETY**

<b>ICAS-88-1.1.1</b>	Simulated Environment Testing for Aircraft P W SMITH .....	1
<b>ICAS-88-1.1.2</b>	Windshear Detection and Avoidance: Airborne Systems Perspective R L BOWLES, R TARG .....	7
<b>ICAS-88-1.1.3</b>	Takeoff Flight-Paths in the Presence of Wind and Wind Variation K -U HAHN .....	21
<b>ICAS-88-1.1.4</b>	Results from a Programme of Low Altitude Atmospheric Turbulence Measurements by an Instrumented Aircraft G W FOSTER, J G JONES .....	32

## **HYPersonic AEROTHERMODYNAMICS**

<b>ICAS-88-2.1.1</b>	Recent European Advancements in Hypersonic Aerodynamics and Aerothermics related to 'HERMES' Program P PERRIER .....	not available
<b>ICAS-88-2.1.2</b>	Effects of Reynolds Numbers on Static Characteristics of Aerodynamics of a Slender Cone Q Y ZHUANG .....	43
<b>ICAS-88-2.1.3</b>	Heat Transfer Measurements on Biconics at Incidence in Supersonic High Enthalpy Air & Nitrogen Flows S L GAI, T CAIN, W S JOE, R J SANDEMAN, C G MILLER .....	48
<b>ICAS-88-2.1.4</b>	Sensitivity of Supersonic Combustion to Combustor/ Flameholder Design G S DISKIN, G BURTON NORTHAM .....	58

## **FATIGUE AND DAMAGE TOLERANCE**

<b>ICAS-88-3.1.1</b>	Fatigue Crack Growth Under Cyclic Compression Role of First Load Cycle A F BLOM, D K HOLM, S SURESH .....	67
<b>ICAS-88-3.1.2</b>	Damage Tolerance and Engineering Properties of Aluminium-Lithium Alloys W G J 't HART, L SCHRA, R J H WANHILL .....	75
<b>ICAS-88-3.1.3</b>	Fracture Mechanics and Fatigue Characterization of Aluminium-Lithium Alloys G CAVALLINI, L LAZZERI, F BOSCHETTI, A SOLINA, M DE SANCTIS .....	84

<b>ICAS-88-3.1.4</b>	A New Approach to Load Transfer in Bolted Joints V WEISSBERG, K WANDER, R ITZHAKOV .....	96
----------------------	--	----

#### **LAMINAR FLOW**

<b>ICAS-88-4.1.1</b>	Natural Laminar Flow Research for Subsonic Transport Aircraft in the FRG H KÖRNER .....	not available
<b>ICAS-88-4.1.2</b>	Toward Lower Drag with Laminar Flow Technology W D HARVEY, P J BOBBITT .....	not available
<b>ICAS-88-4.1.3</b>	A Study of Viscous Flow Over Elliptic Cylinders R BAHL .....	102
<b>ICAS-88-4.1.4</b>	Design and Experimental Verification of an Advanced Fowler Flapped Natural Laminar Flow Airfoil R BERTOCCHI .....	113

#### **CFD APPLICATIONS TO PROPULSION**

<b>ICAS-88-5.1.1</b>	Three Dimensional Inviscid Flow Calculations in Turbomachinery Components T ARTS .....	121
<b>ICAS-88-5.1.2</b>	Numerical Simulation of Turbulent Flow Through Tandem Cascade D XU, G WU .....	133
<b>ICAS-88-5.1.3</b>	3D Computations of Complex Internal Flow Systems C HIRSCH, C LACOR .....	not available
<b>ICAS-88-5.1.4</b>	Calculation of Flow Along a Cowl of a Shrouded Propfan Using a 3D-Euler Code S LEICHER .....	138

## **HELICOPTER FLIGHT DYNAMICS**

<b>ICAS-88-6.1.1</b>	Experimental Investigation of Strong In-Flight Oscillation on Helicopters and its Prevention X ZHI-MING .....	148
<b>ICAS-88-6.1.2</b>	Optimization of Helicopter Takeoff and Landing T CERBE, G REICHERT .....	154
<b>ICAS-88-6.1.3</b>	Theoretical Modelling for Helicopter Flight Dynamics: Development and Validation G D PADFIELD .....	165

## **ACTIVE CONTROL TECHNOLOGY**

<b>ICAS-88-1.2.1</b>	Integrated Control Technology for Commuter Aircraft Experimental Results and Future Potential W ALLES, H BÖHRET, H WÜNNENBERG .....	178
<b>ICAS-88-1.2.2</b>	Active Flutter Suppression for a Wing Model G L GHIRINGHELLI, M LANZ, P MANTEGAZZA .....	184
<b>ICAS-88-1.2.3</b>	ACT Wind Tunnel Experiments of a Transport-Type Wing T UEDA, H MATSUSHITA, S SUZUKI, Y MIYAZAWA .....	194
<b>ICAS-88-1.2.4</b>	Multivariable Control System Design for an Unstable Canard Aircraft D COWLING .....	205

## **TRANSPORT AIRCRAFT I**

<b>ICAS-88-2.2.1</b>	Transonic Investigations on High Aspect Ratio Forward- and Aft-Swept Wings T OHNUKI, N KAMIYA .....	216
<b>ICAS-88-2.2.2</b>	Design Philosophy of Long Range LFC Transports with Advanced Supercritical LFC Airfoils W PFENNINGER, C S VERMURU .....	223
<b>ICAS-88-2.2.3</b>	Aerodynamic Design and Integration of a Variable Camber Wing for a New Generation Long/Medium Range Aircraft E GREFF .....	242

## OPTIMAL AIRCRAFT GUIDANCE

<b>ICAS-88-3.2.1</b>	Open Loop Optimal Control of Multi-Engine Aircraft After One Engine Failure W JIANPEI, B KAUFMANN .....	255
<b>ICAS-88-3.2.2</b>	Maximum Recovery Area in Approach for the Space Plane Hermes F JOUHAUD .....	269
<b>ICAS-88-3.2.3</b>	On Minimum Time to Point, Maneuver, and Shoot: Singular Perturbation Feedback Law in Head-On-Pass Engagement H STALFORD, E HOFFMAN .....	275
<b>ICAS-88-3.2.4</b>	Real-Time Guidance Laws for Three-Dimensional Interception M DO KHAC, H T HUYNH .....	287

## TURBULENCE MODELLING

<b>ICAS-88-4.2.1</b>	Comparison of Differential Reynolds Stress and k- $\epsilon$ Turbulence Models for the Driven Cavity Problem R K COOPER, M WOLFSSTEIN, M BEHNIA, G DE VAHL DAVIS, J REIZES .....	297
<b>ICAS-88-4.2.2</b>	Numerical Simulation of an Unsteady Turbulent Flow Past a Sudden Expansion Y GAGNON, A GIOVANNINI .....	307
<b>ICAS-88-4.2.3</b>	Efficient Numerical Simulation of Turbulent Flows E ARAD, M WOLFSSTEIN .....	317
<b>ICAS-88-4.2.4</b>	A Direct Aerofoil Performance Code Incorporating Laminar Separation Bubble Effects F N COTON, R A McD GALBRAITH .....	329

## COMPOSITES I

<b>ICAS-88-5.2.1</b>	Delamination Buckling of Cylindrical Laminates G J SIMITSES, Z Q CHEN, S SALLAM .....	339
<b>ICAS-88-5.2.2</b>	Buckling of Edge-Damaged Cylindrical Composite Shells M SABAG, Y STAVSKY, J B GREENBERG .....	not available
<b>ICAS-88-5.2.3</b>	Dynamic Buckling of Composite Plates and Columns Under Axial Impact T WELLER, J SINGER, H ABRAMOVICH, H RÖHRLE K JORDE .....	not available
<b>ICAS-88-5.2.4</b>	A Geometrically Nonlinear Theory of Shear Deformable Laminated Composite Plates and Its Use in the Postbuckling Analysis L LIBRESCU, M STEIN .....	349

## CERTIFICATION

<b>ICAS-88-6.2.1</b>	The FAA Designee System and its Contribution to Commercial Aviation F W ZAPPERT, H A PARKER .....	360
<b>ICAS-88-6.2.2</b>	A Review of Requirements, Design Considerations and Resulting Experience for Extended Range Operation of Two-Engine Airplanes C F FICKEISEN .....	368
<b>ICAS-88-6.2.3</b>	International Regulations for the Safe Transport of Dangerous Goods J L COX .....	374
<b>ICAS-88-6.2.4</b>	Application of Physiological Measures to the Estimation of Pilot's Mental State R L HARRIS, A T POPE .....	not available

## MISSILE GUIDANCE AND CONTROL

<b>ICAS-88-1.3.1</b>	Optimal Guidance Law for a Bank-to-Turn Missile Y Di, Z Lan, X Gao, Y Wu, S Tang .....	not available
<b>ICAS-88-1.3.2</b>	Optimal Guidance for High Order and Acceleration Constrained Missile L RUSNAK, L MEIR .....	383
<b>ICAS-88-1.3.3</b>	Real-Time Analysis of Microcomputer-Based Adaptive Flight Control Systems J CHEN, Y OU, Y WANG, J LIAN, C LU, S SU .....	392

## HYPersonic STRUCTURES AND MATERIALS

<b>ICAS-88-2.3.1</b>	Materials and Structures for Hypersonic Vehicles D R TENNEY, W B LISAGOR, S C DIXON .....	398
<b>ICAS-88-2.3.2</b>	Metallic Thermal Protection Concept for Aerodynamic Controlled Hypersonic Vehicles H GRALLERT, K KELLER .....	416
<b>ICAS-88-2.3.3</b>	Application of Integrated Fluid-Thermal-Structural Analysis Methods A R WIETING, P DECHAUMPHAI, K S BEY, E A THORNTON, K MORGAN .....	424
<b>ICAS-88-2.3.4</b>	On the Determination of Heat Transfer in Structures of Re-Entry Vehicles C HABERLAND, A LAHRMANN, W NITSCHE .....	not available

## AIRCRAFT CONTROL IN WINDSHEAR

<b>ICAS-88-3.3.1</b>	On the Compensation of the Phugoid Mode Induced by Initial Conditions and Windshears L M B C CAMPOS .....	435
<b>ICAS-88-3.3.2</b>	Optimization and Guidance of Landing Trajectories in a Windshear A MIELE, T WANG, W W MELVIN .....	445
<b>ICAS-88-3.3.3</b>	Airbus Airborne Windshear System and Windshear Warning Design Process P CAMUS, J L BONAFE .....	463

## PLANFORM OPTIMISATION

<b>ICAS-88-4.3.1</b>	Turbulent Flow Measurement Behind the Wing/Body Junction of an Airbus A310 Model J OLSSON, J SZODRUCH .....	not available
<b>ICAS-88-4.3.2</b>	An Aerodynamic Comparison of Planar and Non-Planar Outboard Wing Planforms D A NAIK, C OSTOWARI .....	468
<b>ICAS-88-4.3.3</b>	Flow Properties Associated with Wing/Body Junctions in Wind Tunnel and Flight A BERTEL RUD, J SZODRUCH, J OLSSON .....	481

## COMPOSITES II

<b>ICAS-88-5.3.1</b>	Large Deflections of Laminated Composite Plates and Shells R SCHMIDT .....	not available
<b>ICAS-88-5.3.2</b>	Dynamic Stability of Transversely Isotropic Viscoelastic Flat Plates L LIBRESCU, N K CHANDIRAMANI .....	495
<b>ICAS-88-5.3.3</b>	Optimization of Conical Anisotropic Shells G V VASILIEV, G N ADAM .....	506

## UNSTEADY AERODYNAMICS - NONVISCID MODELLING

<b>ICAS-88-6.3.1</b>	Unsteady Transonic Flows Past Airfoils and Wings Using a Fast Implicit Godunov Type Euler Solver A BRENNEIS, A EBERLE .....	not available
<b>ICAS-88-6.3.2</b>	Thickness Effects in the Unsteady Aerodynamics of Interfering Lifting Surfaces L P RUIZ-CALAVERA, W GEISSLER .....	514
<b>ICAS-88-6.3.3</b>	Unsteady Supersonic Flow Computations for Arbitrary Three-Dimensional Configurations D D LIU, P C CHEN, P GARCIA-FOGEDA .....	524

## AIR TRAFFIC CONTROL

<b>ICAS-88-1.4.1</b>	ATSAM (Air Traffic Simulation Analysis Model) A Simulation-Tool to Analyze En-Route Air Traffic Scenarios A HÖRMANN .....	545
<b>ICAS-88-1.4.2</b>	Flight Simulations on MLS-Guided Interception Procedures and Curved Approach Path Parameters L J J ERKELENS .....	554
<b>ICAS-88-1.4.3</b>	Approach Flight Guidance of a Regional Air Traffic Aircraft Using GPS in Differential Mode T JACOB .....	566
<b>ICAS-88-1.4.4</b>	In-Flight Inertial Guidance Alignment D GOSHEN-MESKIN, I Y BAR-ITZHACK .....	575

## MODERN PROPELLER AERODYNAMICS

<b>ICAS-88-2.4.1</b>	From Single Rotating Propfan to Counter Rotating Ducted Propfan Propeller/Fan Characteristics M LECHT .....	578
<b>ICAS-88-2.4.2</b>	Single and Contra-Rotation High Speed Propellers: Flow Calculation and Performance Prediction P W C WONG, M MAINA, C R FORSEY, A J BOCCI .....	589
<b>ICAS-88-2.4.3</b>	From Single-Rotating Propfan to Counter-Rotating Ducted Propfan Propeller/Fan Characteristics P SCHIMMING .....	not available
<b>ICAS-88-2.4.4</b>	Experimental and Numerical Study of Propeller Wakes in Axial Flight Regime D FAVIER, A ETTAOUIL, C MARESCA, C BARBI .....	602

## DYNAMICS AND FATIGUE

ICAS-88-3.4.1	In-Flight Processing of Aircraft Fatigue Loads from Aerodynamic Parameters D BARUCH, A BERKOVITS .....	not available
ICAS-88-3.4.2	Fatigue Life Improvement of Thick Sections by Hole Cold Expansion J Y MANN, P W BEAVER, J G SPARROW .....	617
ICAS-88-3.4.3	The Use of Static Analysis and the Stress Modes Approach as an Engineering Oriented Procedure for Calculating the Response of Aeronautical Structures to Random Excitation G MAYMON .....	626
ICAS-88-3.4.4	Quadrilateral Coons Surface Shell Finite Element with Discrete Principal Curvature Lines T Q YE, Y ZHAO .....	631

## AERODYNAMIC DESIGN NUMERICAL METHODS

ICAS-88-4.4.1	Aerodynamic Optimization K -W BOCK .....	not available
ICAS-88-4.4.2	Subsonic Aerodynamic Prediction of Shuttle-Like Configurations Using Nonlinear Vortex-Lattice Method D ALMOSNINO, J ROM .....	638
ICAS-88-4.4.3	Computational Aerodynamic Design Concepts for Futuristic Air Combat S C GUPTA .....	644
ICAS-88-4.4.4	Navier-Stokes Computation of High-Speed Wing Flow A RIZZI, C ERIKSSON .....	not available

## VORTEX FLOWS - VISCOUS EFFECTS

ICAS-88-5.4.1	Investigations on the Vorticity Sheets of a Close-Coupled Delta-Canard Configuration H -C OELKER, D HUMMEL .....	649
ICAS-88-5.4.2	Study of Three-Dimensional Effects of Vortex Breakdown M D SALAS, G KURUVILA .....	663
ICAS-88-5.4.3	Numerical and Experimental Determination of Secondary Separation at the Leeward Side of a Delta Wing in Compressible Flow E M HOUTMAN, W J BANNINK .....	673

<b>ICAS-88-5.4.4</b>	Investigation of Flow Over Cavity-Blunt Body Combination at Supersonic Speed O H RHO, D H LEE, J H KIM .....	681
----------------------	---	-----

#### HYPersonic VEHICLE DESIGN AND PROPULSION

<b>ICAS-88-1.5.1</b>	Sänger II, A Hypersonic Flight and Space Transportation System D E KOELLE .....	687
<b>ICAS-88-1.5.2</b>	Air Breathing Combined Engines for Space Transportation Systems A LARDELLIER, M POULIQUEN .....	694
<b>ICAS-88-1.5.3</b>	Driving Mechanisms in Unstable Ramjet Combustors U G HEDGE, D REUTER, B T ZINN .....	701

#### INLETS AND NOZZLES

<b>ICAS-88-2.5.1</b>	New Guide for Accurate Navier-Stokes Solution of Two-Dimensional External Compression Inlet with Bleed C K FORESTER, E TJONNELAND .....	709
<b>ICAS-88-2.5.2</b>	Numerical Prediction of Flow Entrainment Around a V/STOL Aircraft in Ground Effect C M MILFORD .....	not available
<b>ICAS-88-2.5.3</b>	Investigation of the Pressure Distribution in 2D Rocket Nozzle with Mechanical System for T V C T DRAGOVIC, B JOJIC, Z STEFANOVIĆ .....	719

#### EMERGING MATERIALS

<b>ICAS-88-3.5.1</b>	The Design of Aerospace Materials for the Future C J PEEL, R MORETON .....	724
<b>ICAS-88-3.5.2</b>	Emerging Materials Technologies for Future Aero Gas Turbines A HIRST .....	not available
<b>ICAS-88-3.5.3</b>	Some Novel Test Methods for, and Associated Problems of, Mechanical Strength Characterisation of Engineering Ceramics G R ESSAM, G SYERS .....	744

## VORTEX FLAPS

<b>ICAS-88-4.5.1</b>	Effectiveness of Combination of Apex and Leading-Edge Vortex Flap on a 74 Degree Delta-Wing or Without Trailing-Edge Flap T D HSING, K X SHEN, Z F WANG, W H GUO, F G ZHUANG .....	749
<b>ICAS-88-4.5.2</b>	The Behaviour and Performance of Leading-Edge Vortex Flaps D G ELLIS, J L STOLLERY .....	758
<b>ICAS-88-4.5.3</b>	Control-Configured Vortex Flaps - A Feasibility Study D M RAO .....	not available

## UNSTEADY AERODYNAMICS - VISCOUS MODELLING

<b>ICAS-88-5.5.1</b>	Viscous/Inviscid Interaction Procedure for High-Amplitude Oscillating Airfoils W GEISSLER, L W CARR, T CEBECI .....	766
<b>ICAS-88-5.5.2</b>	Time-Consistent Computation of Transonic Buffet Over Airfoils P GIRODROUX-LAVIGNE, J C Le BALLEUR .....	779
<b>ICAS-88-5.5.3</b>	Application of Unsteady Aerodynamic Methods for Transonic Aeroelastic Analysis W WHITLOW .....	788

## TRANSPORT AIRCRAFT II

<b>ICAS-88-1.6.1</b>	Transgression Investigations of Helicopter Dynamics K SZUMAŃSKI .....	797
<b>ICAS-88-1.6.2</b>	The Aerodynamic Development of the Fokker 100 E OBERT .....	807
<b>ICAS-88-1.6.3</b>	Evolution of the LAVI Fighter Aircraft S TSACH, A PELED .....	827
<b>ICAS-88-1.6.4</b>	Design Evolution for a New Regional Airliner J SPINTZYK, H KROJER .....	not available

## GAS TURBINE TECHNOLOGY

<b>ICAS-88-2.6.1</b>	3D Flow Computations in a Centrifugal Compressor With Splitter Blade Including Viscous Effect Simulation V MILLOUR .....	842
<b>ICAS-88-2.6.2</b>	Detailed Measurements of the Flow in the Vaned Diffuser of a Backswept Transonic Centrifugal Impeller Ch FRADIN .....	848
<b>ICAS-88-2.6.3</b>	Aerodynamic Response of Multi-State Blade Rows S FLEETER .....	not available
<b>ICAS-88-2.6.4</b>	Optical Diagnostic for Air Breathing Engines Y LEVY, Y M TIMNAT .....	855

## SYSTEMS EVALUATION

<b>ICAS-88-3.6.1</b>	Flight Evaluation of the ATTAS Digital Fly-By-Wire/ Light Flight Control System D HANKE, H -H LANGE .....	866
<b>ICAS-88-3.6.2</b>	An Intelligent Fiberoptic Data Bus for Fly-By-Light Applications L C MANOHARAN, S MUTHUVEL .....	877
<b>ICAS-88-3.6.3</b>	Digital Electronics on Small Helicopter Engines K J HICKS .....	880
<b>ICAS-88-3.6.4</b>	Engine Control - A New High Accuracy Pressure Sensor J PASCAL, H BARNY, H FIMA .....	886

## CFD METHODS - I

<b>ICAS-88-4.6.1</b>	Accuracy Versus Convergence Rates for a Three Dimensional Multistage Euler Code E TURKEL .....	892
<b>ICAS-88-4.6.2</b>	An Artificial Viscosity Model and Boundary Condition Implementation of Finite Volume Methods for the Euler Equations L WANG, F ZHUANG .....	898

<b>ICAS-88-4.6.3</b>	Numerical Simulation of Transonic Wing Flows using a Zonal Euler / Boundary-Layer / Navier-Stokes Approach M A ZCHMATZ, F MONNOYER, K M WANIE .....	not available
<b>ICAS-88-4.6.4</b>	Numerical Simulation of 2-D Turbulent Flow Fields With Strong Separation W FRITZ .....	not available

### COMPOSITES III

<b>ICAS-88-5.6.1</b>	Buckling and Postbuckling Behaviour of Composite Panels B GEIER .....	904
<b>ICAS-88-5.6.2</b>	Postbuckling of Eccentric Open-Section Stiffened Composite Panels M STEIN .....	913
<b>ICAS-88-5.6.3</b>	The Buckling and Postbuckling Behaviour of Curved CFRP Laminated Shear Panels K WOLF, H KOSSIRA .....	920
<b>ICAS-88-5.6.4</b>	Post-Buckling Behaviour of Laminated Composite Stiffeners and Stiffened Panels Under Cyclic Loading Y FROSTIG, G SITON, A SEGAL, I SHEINMAN, T WELLER .....	931

**VOLUME II**

**TRANSPORT AIRCRAFT III**

<b>ICAS-88-1.7.1</b>	The Designer's Impact on Commercial Aircraft Economics A L JACOBSON, D G MURPHY .....	945
<b>ICAS-88-1.7.2</b>	Influence of EFCS-System Failures on Structural Design of Modern Transport Aircraft M BESCH .....	not available
<b>ICAS-88-1.7.3</b>	Sensitivity Analysis and Multidisciplinary Optimization for Aircraft Design: Recent Advances and Results J SOBIESZCZANSKI-SOBIESKI .....	953
<b>ICAS-88-1.7.4</b>	High Speed Commercial Transport Study Status Report M MACKINNON .....	not available

**ULTRALIGHTS AND SAILPLANES**

<b>ICAS-88-2.7.1</b>	The Calculation of Aerodynamic Forces on Flexible Wings of Agricultural Aircraft T GAUSZ .....	965
<b>ICAS-88-2.7.2</b>	Aerodynamic and Structural Design of the Standard Class Sailplane ASW-24 L M M BOERMANS, G WAIBEL .....	969
<b>ICAS-88-2.7.3</b>	Man Powered Aircraft - State of the Art 1987 G M LILLEY, P G FIELDING .....	not available
<b>ICAS-88-2.7.4</b>	Flight Mechanical Analysis of Procedure Turns in Agricultural Aviation I LOVRO .....	not available

## **BOUNDARY LAYER CONTROL**

<b>ICAS-88-3.7.1</b>	Flight and Windtunnel Investigations on Boundary Layer Transition at Reynolds Numbers up to $10^7$ K H HORSTMANN, A QUAST, G REDEKER .....	979
<b>ICAS-88-3.7.2</b>	Experimental Study of the Behaviour of NACA 0009 Profile in a Transonic LEBU Configuration J P BONNET, J DELVILLE, J LEMAY .....	987
<b>ICAS-88-3.7.3</b>	Turbulent Boundary Layer Manipulation in Zero Pressure Gradient E COUSTOLS, J COUSTEIX .....	999
<b>ICAS-88-3.7.4</b>	Laminar Flow Control Leading Edge Systems in Simulated Airline Service R D WAGNER, D V MADDALON, D F FISHER .....	101 <sup>4</sup>

## **CFD METHODS II**

<b>ICAS-88-4.7.1</b>	A Parallel Algorithm of AF-2 Scheme for Plane Steady Transonic Potential Flow with Small Transverse Disturbance S-Y LI, Q-W LIAO, D-J LUO .....	1024
<b>ICAS-88-4.7.2</b>	The Embedded Grid-Concept and TSP Methods Applied to the Calculation of Transonic Flow About Wing/Body/Nacelle/Pylon-Configurations W DIEGIAN, S G HEDMAN .....	1029
<b>ICAS-88-4.7.3</b>	Multigrid Computation of Transonic Flow About Complex Aircraft Configurations, using Cartesian Grids and Local Refinement B EPSTEIN, A L LUNTZ, A NACHSHON .....	1038
<b>ICAS-88-4.7.4</b>	Towards a General Three-Dimensional Grid Generation System L G TYSELL, S G HEDMAN .....	1047

## **AEROELASTICITY I**

<b>ICAS-88-5.7.1</b>	Research and Application in Aeroservoelasticity at the NASA Langley Research Center I ABEL, T E NOLL .....	1059
<b>ICAS-88-5.7.2</b>	Aircraft Aeroelasticity and Structural Dynamics Research at the NASA Langley Research Center-Some Illustrative Results R V DOGGETT JR, F W CAZIER JR .....	1072

<b>ICAS-88-5.7.3</b>	Optimization of Nonlinear Aeroelastic Tailoring Criteria F ABDI, H IDE, V J SHANKAR, J S SOBIESKI .....	1083
<b>ICAS-88-5.7.4</b>	Aeroelasticity and Structural Optimization of Rotor Blades with Swept Tips P P FRIEDMANN, R CELI .....	1092

#### METALLIC ALLOYS

<b>ICAS-88-6.7.1</b>	Behaviour of Aluminum-Lithium Alloys in Typical Aircraft Structural Applications J C EKVALL, D J CHELLMAN .....	not available
<b>ICAS-88-6.7.2</b>	Alloy Design, Microstructure and Mechanical Properties of Superlight High Stiffness Aluminium-Lithium Materials M PETERS, W BUNK .....	1109
<b>ICAS-88-6.7.3</b>	N18, A new High Strength, Damage Tolerant PM Superalloy for Turbine Discs Application A WALDER, M MARTY, J L STURDEL, E BACHELET, J H DAVIDSON, J F STOHR .....	1120

#### MEASUREMENT AND CRASHWORTHINESS

<b>ICAS-88-1.8.1</b>	A System for Measuring, Recording and Processing Flight Test Data J T M VAN DOORN, P J H M MANDERS, O VAN TEUNENBROEK .....	1127
<b>ICAS-88-1.8.2</b>	Non-Destructive Methods Applied to Aviation Equipment Testing in Service J LEWITOWICZ .....	1145
<b>ICAS-88-1.8.3</b>	Application of a Flight Performance Advisory System to the F/A-18 Aircraft M J FRIEDMAN .....	not available
<b>ICAS-88-1.8.4</b>	Damage Development in Composite Materials During Fatigue, Impact and Hygrothermal Loading I H J M VERPOEST, M G T WEVERS .....	not available

## ADVANCES AVIONICS

ICAS-88-2.8.1	The Design, Development and Integration of the Complex Avionics Systems P SCHIRLÉ .....	1155
ICAS-88-2.8.2	Optimal Integration of Inertial Sensor Functions for Flight Control and Navigation U KROGMANN .....	not available
ICAS-88-2.8.3	Central Fault Display Systems F VAUVERSIN, J P POTOCKI DE MONTALK .....	1164
ICAS-88-2.8.4	Fit and Forget Avionics T G HAMILL .....	not available

## WIND TUNNEL TESTING

ICAS-88-3.8.1	Some New Test Results in the Adaptive Rubber Tube Test Section of the DFVLR Gottingen A HEDDERGOTT, E WEDEMEYER .....	1172
ICAS-88-3.8.2	Application of a Flexible Wall Testing Technique to the NASA Langley 0.3-m Transonic Cryogenic Tunnel S W D WOLF .....	1181
ICAS-88-3.8.3	Blockage Corrections at High Angles of Attack in a Wind Tunnel P A GILI, D M PASTRONE, F B QUAGLIOTTI, E BARBANTINI .....	1192
ICAS-88-3.8.4	Cryogenic Wind Tunnels for High Reynolds Number Testing R A KILGORE, P L LAWING .....	1199

## CFD APPLICATIONS TO AIRCRAFT DESIGN

ICAS-88-4.8.1	NAS - The First Year F R BAILEY, P KUTLER .....	1210
ICAS-88-4.8.2	Recent Developments and Industrial Applications of Euler- and Navier-Stokes-Solvers B WAGNER, W SCHMIDT .....	not available
ICAS-88-4.8.3	An Efficient Method for Computing Transonic and Supersonic Flows About Aircraft G VOLPE, A JAMESON .....	1224
ICAS-88-4.8.4	Managing CFD in Industry R H WICKEMEYER .....	1237

## STRUCTURAL TESTING

ICAS-88-5.8.1	A320 Full Scale Structural Testing for Fatigue and Damage Tolerance Certification of Metallic and Composite Structure B BRANDECKER, R HILGERT .....	1244
ICAS-88-5.8.2	Summary of the Kfir Fatigue Evaluation Program E REINBERG, A BROT .....	1257
ICAS-88-5.8.3	Space Shuttle Orbiter Windshield Bird Impact Analysis K S EDELSTEIN, R E McCARTY .....	1267
ICAS-88-5.8.4	Multi-Mode GVT/FEM Correlation S SIEGEL, V K GUPTA .....	1275

## HIGH ANGLE OF ATTACK (UNSTEADY)

ICAS-88-6.8.1	The Application and Improvement of "Wall Pressure Signature" Correction Method for the Tunnel Wall Interference J GUIQING .....	1291
ICAS-88-6.8.2	Analysis of Fluctuating Pressure on a Nose-Cylinder Body Measured in a Transonic Wind Tunnel M EBIHARA, Y AIHARA .....	not available
ICAS-88-6.8.3	Unsteady Motion of Vortex-Breakdown Positions on Delta Wings H PORTNOY .....	1299

## MATHEMATIC MODELLING & SIMULATION

ICAS-88-1.9.1	Design of Higher Bandwidth Model Following for Flight Vehicle Stabilization and Control F HENSCHEL, G BOUWER .....	1304
ICAS-88-1.9.2	Phase II Flight Simulator Mathematical Model and Data-Package, Based on Flight Test and Simulation Techniques A M H NIEUWPOORT, J H BREEMAN, M BAARSPUL J A MULDER .....	1311
ICAS-88-1.9.3	Sensitivity of Reduced Flight Dynamic Model Depending on Elasticity of Aircraft Structure J JANKOVIC .....	1328

## PROPELLER NOISE

- ICAS-88-2.9.1** Predicting the Noise of Counter-Rotating Propellers  
J M CAILLEAU .....not available /
- ICAS-88-2.9.2** Analysis of the Transmission of Sound into the Passenger Compartment of a Propeller Aircraft Using the Finite Element Method  
P GORANSSON, F DAVIDSSON ..... 1334
- ICAS-88-2.9.3** The Ultralight Aeroplane - A "Pain in the Air" or an Environmentally Acceptable Flight Vehicle?  
H HELLER, W DOBRZYNISKI, H DAHLEN ..... 1342

## AIRCRAFT STABILITY AND CONTROL

- ICAS-88-3.9.1** The Study of Global Stability and Sensitive Analysis of High Performance Aircraft at High Angles-of-Attack  
H GAO, Z D HE Z Q ZHOU ..... 1356
- ICAS-88-3.9.2** Determination of Departure Susceptibility and Centre of Gravity Limitations for Control Augmented Aircraft  
M MEDINA, M SHAHAF ..... 1364
- ICAS-88-3.9.3** Aerodynamic Design of a Manual Aileron Control for an Advanced Turbo-Prop Trainer  
O L P MASEFIELD ..... 1374

## LOW SPEED FLOW

- ICAS-88-4.9.1** Experimental Investigation of the Complex 3-D Flow Around a Body of Revolution at Incidence  
G IUSO, M ONORATO, M S OGGIANO, S DE PONTE,  
B YUZHONG, Z XIAODI ..... 1382
- ICAS-88-4.9.2** The Flight Performance of an RPV Compared with Wind Tunnel and Theoretical (CFD) Results  
J L STOLLERY, D J DYER ..... 1392
- ICAS-88-4.9.3** Some Types of Scale Effect in Low-Speed, High-Lift Flows  
D S WOODWARD, B C HARDY, P R ASHILL ..... 1402

## VORTEX FLOWS - N/S EULER EQUATIONS

<b>ICAS-88-5.9.1</b>	Aerodynamic Applications of an Efficient Incompressible Navier-Stokes Solver P -M HARTWICH, C -H HSU, J M LUCKRING, C H LIU .....	1417
<b>ICAS-88-5.9.2</b>	Basic Analysis of the Flow Fields of Slender Delta Wings Using the Euler Equations S SCHERR, A DAS .....	1428
<b>ICAS-88-5.9.3</b>	Modeling of Vortex Dominated Flowfields in the Euler Formulation K D LEE, S A BRANDT .....	1437

## DAMAGE MECHANICS

<b>ICAS-88-6.9.1</b>	Stress Intensity Factor of Three Dimensional Crack at the Edge of a Hole M OORE .....	1451
<b>ICAS-88-6.9.2</b>	The Calculation of Energy Release Rate Components Using the Coupled Strain Energy F WEINSTEIN .....	1461
<b>ICAS-88-6.9.3</b>	Axisymmetrical Response by a Penny-Shaped Interface Crack in Multi-Layered Composites X MA, Z ZOU, W HUANG, C SHAO .....	1466
<b>ICAS-88-6.9.4</b>	Impact of Carbon Fibre Composites J MORTON .....	not available

## OPTIMAL DESIGN

<b>ICAS-88-1.10.1</b>	Controlled Non-Conforming Finite Elements and Data Base as Approach to the Analysis of Aircraft Structure Z BOJANIC, M JOSIFOVIC .....	1472
<b>ICAS-88-1.10.2</b>	Optimal Design of Large Laminated Structures R I WATKINS .....	1480
<b>ICAS-88-1.10.3</b>	Efficient Procedures for the Optimization of Aircraft Structures with a Large Number of Design Variables U -L BERKES, J WIEDEMANN .....	1487
<b>ICAS-88-1.10.4</b>	Variation of Anisotropic Axes Due to Multiple Constraints in Structural Optimization D W MATHIAS, G HORNUNG, H RÖHRLE .....	1498

## AIRCRAFT POWER PLANT CONTROL

- ICAS-88-2.10.1 Mathematical Model of a Turbo-Fan-Engine with Real-Time Capabilities R BROCKHAUS .....not available
- ICAS-88-2.10.2 Toward More Effective Redundancy in Digital Gas Turbine Engine Controls K ROBINSON .....not available
- ICAS-88-2.10.3 A Turbofan System Using a Nonlinear Precompensator and a Model - Following Riccati - Feedback H SÖLTER ..... 1505
- ICAS-88-2.10.4 Propulsion Interface Unit (PIU) Controller on PW1120/DEEC Re-Engined F4 Aircraft I FRISCH, D IVERSON, E TJONNELAND ..... 1511

## TRANSONIC FLOW

- ICAS-88-3.10.1 The Cause and Cure of Periodic Flows at Transonic Speeds J GIBB ..... 1522
- ICAS-88-3.10.2 Calculation and Measurement of Transonic Flows Over Aerofoils with Novel Rear Sections P R ASHILL ..... 1531
- ICAS-88-3.10.3 Experience in Application of Active Vibration Control Technology to a Wind Tunnel Model and to Flying Airbus K KOENIG ..... 1542
- ICAS-88-3.10.4 Transonic Magnus Force on a Finned Configuration M RINGEL, A SEGINGER ..... 1553

## AEROELASTICITY II

- ICAS-88-4.10.1 Flutter Calculation of Flutter Models for JAS 39 Gripen V J E STARK ..... 1559
- ICAS-88-4.10.2 Three Dimensional Flow Simulation with Application to Aeroelastic Analysis J L F AZEVEDO ..... 1570
- ICAS-88-4.10.3 Design and Analysis of a High Speed Composite Material Wing Flutter Model A P N SUTHERLAND ..... 1580
- ICAS-88-4.10.4 Orthogonalisation: A Tool for Improved Test Data D M WILSON ..... 1591

#### **COMPOSITES IV**

<b>ICAS-88-5.10.1</b>	Advanced Composite Development for Large Transport Aircraft R D WILSON .....	1600
<b>ICAS-88-5.10.2</b>	Composite Secondary and Primary Structures for Pilatus Aircraft. Experience from the Development and Considerations for Future Applications V DORER, K WIESLER .....	1605
<b>ICAS-88-5.10.3</b>	New Developments in ARALL Laminates L B VOGELESANG, J W GUNNINK, D CHEN, G H J J ROEBROEKS, A VLOT .....	1615
<b>ICAS-88-5.10.4</b>	Randome Technology M NATTER, H-W SCHRÖDER, W SCHAFER .....	1634

#### **DESIGN OPTIMISATION AND CAD/CAM**

<b>ICAS-88-1.11.1</b>	Integrated CAE-Application of a CAD/CAM System Through the Extensive Use of Interfaces L THIEME .....	1641
<b>ICAS-88-1.11.2</b>	Aircraft Configuration Analysis/Syntesis Expert System: A New Approach to Preliminary Sizing of Combat Aircraft R BARGETTO, B MAZETTI, G GARBOLINO .....	1645
<b>ICAS-88-1.11.3</b>	Computer-Aided Structural Optimisation of Aircraft Structures P BARTHOLOMEW, H WELLER .....	1650
<b>ICAS-88-1.11.4</b>	Computational Design and Efficiency Optimization of Agricultural Airplanes R STAUFENBIEL, T SCHERER, I STEIGER .....	1664

#### **LIFE CYCLE AND RELIABILITY**

<b>ICAS-88-2.11.1</b>	The Review of Progress on the Development of Life Cycle Costing Techniques as an Aid to Procurement and Modification Decisions D W DANIEL .....	not available
<b>ICAS-88-2.11.2</b>	Reliability and Maintenance in Modern Avionics Equipment - A User's Point of View - F J KENNIS .....	1677

<b>ICAS-88-2.11.3</b>	A Reliability and Maintainability Prediction Method for Aircraft Conceptual Design V C SERGHIDES, J P FIELDING .....	1683
<b>ICAS-88-2.11.4</b>	Mechanical Failure Analysis as a Means of Improving Quality Assurance in the Aeronautical Industry M KENDLER, E MAKEVET .....	1693

#### VORTEX FLOWS - EXPERIMENTAL

<b>ICAS-88-3.11.1</b>	Canard / LEF Design for a Multi-Mission Fighter Aircraft M SHEPSHELOVICH, D ABOUDI, E BAHARAV, B EPSTEIN, A LUNTZ .....	1700
<b>ICAS-88-3.11.2</b>	Vortical Flows Around Delta Wings in Unsteady Maneuvers and Gusts R STAUFENBIEL, B STECKEMETZ, S ZHU .....	1714
<b>ICAS-88-3.11.3</b>	Quantitative Flow Field Visualization in Wind Tunnels by Means of Particle Image Velocimetry J KOMPENHANS .....	1725
<b>ICAS-88-3.11.3</b>	Vortex Breakdown - Investigations by Using the Ultrasonic-Laser-Method and Laser-Sheet Technique R H ENGLER .....	1731
<b>ICAS-88-3.11.4</b>	Effects of Maneuver Dynamics on Drag Polars for an Aircraft with Automatic Wing Camber Control J W HICKS, B J MOULTON .....	1738

#### ENGINE/AIRFRAME INTEGRATION

<b>ICAS-88-4.11.1</b>	Low Speed Wind Tunnel Investigation of Propeller Slipstream Aerodynamic Effects on Different Nacelle/Wing Combinations I SAMUELSSON .....	1749
<b>ICAS-88-4.11.2</b>	Very High Bypass Ratio Engines for Commercial Transport Propulsion H SKAVDAHL, R A ZIMBRICK, J L COLEHOUR, G P SALLEE .....	1766
<b>ICAS-88-4.11.3</b>	Aerodynamic Instability Definitions and Their Use in Illustrating Nonrecoverable Stall Technology W G STEENKEN .....	not available
<b>ICAS-88-4.11.4</b>	Engine Surge Simulation in Wind-Tunnel Model Inlet Ducts K W LOTTER, P -A MACKRODT, R D SCHERBAUM .....	1773

**COMPOSITES V**

- ICAS-88-5.11.1** Molding and Joining of Continuous Fiber-Reinforced Polytheretherketone (PEEK)  
G KEMPE, H KRAUSS ..... 1789
- ICAS-88-5.11.2** Stability of Simply Supported Sandwich Panels Having Anisotropic Faces Under Uni-Axial Compressive Load  
R J FRITZ, C DIAMANTAKOS, M A STONE .....not available
- ICAS-88-5.11.3** NDE of Composites Using Lamb Waves: Theory and Experiment  
V DAYAL, V K KINRA .....not available
- ICAS-88-5.11.4** The Measurement and Comparison of Material and Structural Damping in Metal-Matrix Composites  
V K KINRA, G G WREN, A K RAY .....not available

**RESERVE PAPERS**

<b>ICAS-88-1.1R</b>	Icing Degree Moderate to Severe: If and Where in Clouds H-E HOFFMAN .....	1801
<b>ICAS-88-1.5R1</b>	Rarefield-Flow Pitching Moment Coefficient Measure- ments of the Shuttle Orbiter R C BLANCHARD, E W HINSON .....	1813
<b>ICAS-88-1.10R</b>	Integrated Structural-Aerodynamic Design Optimization R T HAFTKA, P J KAO, B GROSSMAN, D POLEN J SOBIESZCZANSKI-SOBIESKI .....	1820
<b>ICAS-88-3.7R</b>	Transonic Shock Boundary Layer Interaction with Passive Control S RAGHUNATHAN, S T MCILWAIN .....	1826
<b>ICAS-88-3.8R</b>	Wind Tunnel Blockage Corrections for Bluff Bodies with Lift G N V RAO, J DHEENADHAYALAN .....	1835
<b>ICAS-88-3.11R2</b>	Flow Field Visualization Study on a 65° Delta Wing K A BUTEFISCH .....	1845
<b>ICAS-88-4.5R</b>	Non Linear Aerodynamics of Delta Wings in Combined Pitch and Roll J ER-EL, D SETER, D WEIHS .....	1852
<b>ICAS-88-4.6R1</b>	Boundary Conditions for Viscous Incompressible Two-Dimensional Flows A DAGAN, R ARIELI .....	1859
<b>ICAS-88-4.9R1</b>	Flow Separation on Yawed Cylinders: Pressures and Wake Surveys S DE PONTE, A ABBA P BORSA .....	1866
<b>ICAS-88-4.9R2</b>	Body Wing Tail Interference Studies of High Angles of Attach and Variable Reynolds Numbers K HARTMANN, V KANAGARAJAN, D NIKOLITSCH .....	1871
<b>ICAS-88-5.7R</b>	Effect of Aerodynamic Heating on Deformation of Composite Cylindrical Panels in a Gas Flow V BIRMAN, C W BERT, I ELISHAKOFF .....	1886
<b>THE INTERNATIONAL COUNCIL OF THE AERONAUTICAL SCIENCES</b>	.....	LXVIII
<b>ICAS PROGRAM PLANNING COMMITTEE</b>	.....	LXIX
<b>ICAS MEMBER ASSOCIATIONS</b>	.....	LXX
<b>ICAS ASSOCIATE MEMBERS</b>	.....	LXXIV