

CONTENTS

INVITED LECTURES

B E LAUNDER: Turbulence Modelling for the Nineties: Second-Moment Closure ... and Beyond?.....	1
B L ROZHDESTVENSKY, M I STOYNOV: Simulation of Turbulent Flows by Numerical Integration of Navier-Stokes Equations.....	19
E KRAUSE: The Solution to the Problem of Vortex Breakdown	35
J-P VEUILLOT, L CAMBIER: Computation Techniques for the Simulation of Turbomachinery Compressible Flows	51
A N STANIFORTH, J CÔTÉ: Semi-Lagrangian Integration Schemes and their Application to Environmental Flows.....	63
T D TAYLOR: Computer Trends for CFD	80
T AKI: Computation of Shock-Shock Interference Around a Cylindrical Leading Edge at Hypersonic Speeds.....	90

CONTRIBUTED PAPER SESSIONS

Transition, Turbulence and Solution of Navier-Stokes Equations

T H PULLIAM, J A VASTANO: Chaotic Flow Over an Airfoil.....	106
K P DIMITRIADIS, M A LESCHZINER: Modelling Shock/Turbulent-Boundary-Layer Interaction with a Cell-Vertex Scheme and Second-Moment Closure.....	111
T DUBOIS, F JAUBERTEAU, R TEMAM: The Nonlinear Galerkin Method for the Two and Three Dimensional Navier-Stokes Equations.....	116
G ERLEBACHER, M Y HUSSAINI, C G SPEZIALE, T A ZANG: On the Large-Eddy Simulation of Compressible Isotropic Turbulence.....	121
Y NAKAMURA, J P WANG, M YASUHARA: A Calculation of the Compressible Navier-Stokes Equations in Generalized Coordinates by the Spectral Method	127
D KWAK, S E ROGERS, C KIRIS, S YOON: Numerical Methods for Viscous Incompressible Flows	132

G KURUVILA, M D SALAS: Three-Dimensional Simulation of Vortex Breakdown	137
S C R DENNIS, J D HUDSON: Accurate Finite-Difference Methods for Solving Navier-Stokes Problems Using Green's Identities	142
M SANCHEZ, N K MITRA, M FIEBIG: Influence of Longitudinal Vortices on the Structure of the Three Dimensional Wake of a Partially Enclosed Body	147
F J BRANDSMA, J G M KUERTEN: The ISNaS Compressible Navier-Stokes Solver; First Results for Single Airfoils	152
T B GATSKI, E J KERSCHEN: Leading-Edge Effects on Boundary-Layer Receptivity	157
R ARINA, C CANUTO: The Viscous-Inviscid Coupling via a Self-Adaptive Domain Decomposition Technique	162
N-H CHO, C A J FLETCHER, K SRINIVAS: Efficient Computation of Wing Body Flows	167
H I ANDERSSON, J T BILLDAL, P ELIASSON, A RIZZI: Staggered and Non-Staggered Finite-Volume Methods for Nonsteady Viscous Flows: A Comparative Study	172
O M BELOTSEKOVSKII: Direct Numerical Modelling of Turbulence: Coherent Structures and Transition to Chaos	177
A KARAGEORGHIS, T N PHILLIPS: Conforming Chebyshev Spectral Collocation Methods for the Solution of the Incompressible Navier-Stokes Equations in Complex Geometries	179
I N SIMAKIN, S E GRUBIN: Direct Simulation of Transition and Turbulent Boundary Layer	181
H TOKUNAGA, K ICHINOSE, N SATOFUKA: Numerical Simulation of Transition to Turbulence Using Higher Order Method of Lines	183
M FERRY, J PIQUET: A New Fully-Coupled Method for the Solution of Navier-Stokes Equations	186
R RADESPIEL, N KROLL: A Multigrid Scheme with Semicoarsening for Accurate Computations of Viscous Flows	188

G DANABASOGLU, S BIRINGEN, C L STREETT: Numerical Simulation of Spatially-Evolving Instability in Three-Dimensional Plane Channel Flow	190
D PRUETT, G ERLEBACHER, L NG: Secondary Instability and Transition in Compressible Boundary Layers	192
K B WINTERS, E A D'ASARO, J J RILEY: Three-Dimensional Internal Wave Breaking at a Critical Level	195
F F GRINSTEIN, J P BORIS: Numerical Simulation of Transitional Bluff-Body Near-Wake Shear Flows	197
V THEOFILIS, P W DUCK, D I A POLL: On the Stability of the Infinite Swept Attachment Line Boundary Layer	199
T KAJISHIMA, Y MIYAKE, T NISHIMOTO: Large Eddy Simulation of Turbulent Flow in a Duct of Square Cross Section	202
R I LEIGHTON, T F SWEAN JR: Direct Numerical Simulation of Turbulent Flow in an Open Channel	205
H L CHEN, K OSHIMA: Direct Numerical Simulation of a Complicated Transition-Breakdown of a Circular Pipe Flow through Axisymmetric Sudden Expansions	207
Y KATO, T SATO, T SAWADA, T TANAHASHI: Numerical Simulation of Unsteady Incompressible Viscous Flows by Improved GSMAC-FEM.....	209
P LE QUÉRÉ, A DULIEU, T PHUOC LOC: Investigation of 2-D and 3-D Instability of the Driven Cavity Flow	211
B TROFF, T H LÊ, T PHUOC LOC: Numerical Simulation of Three-Dimensional Unsteady Incompressible Viscous Flow for Separated Configurations	213
G A OSSWALD, K N GHIA, U GHIA: Flow Over Arbitrary Axisymmetric Multi-Body Configurations, Using Direct Navier-Stokes Simulations	215
Algorithm Development and Parallel Computing	
A A SAMARSKY, A P FAVORSKY, V F TISHKIN, V F VASILEVSKY, K V VYAZNIKOV: Construction High Order Monotonous Difference Schemes on Nonregular Grids	219

H-C KU, A P ROSENBERG, T D TAYLOR: High-Order Time Integration Scheme and Preconditioned Residual Method for Solution of Incompressible Flow in Complex Geometries by the Pseudospectral Element Method	223
D J MAVRIPLIS: Turbulent Flow Calculations Using Unstructured and Adaptive Meshes	228
V VENKATAKRISHNAN, J H SALTZ, D J MAVRIPLIS: Parallel Preconditioned Iterative Methods for the Compressible Navier-Stokes Equations	233
P VAN RANSBEECK, C LACOR, C HIRSCH: A Multidimensional Cell-Centered Upwind Algorithm Based on a Diagonalization of the Euler Equations	238
P I CRUMPTON, J A MACKENZIE, K W MORTON, M A RUDGYARD, G J SHAW: Cell Vertex Multigrid Methods for the Compressible Navier-Stokes Equations	243
J Y YANG, C-A HSU, T H LEE: A Numerical Study of Third-Order Nonoscillatory Schemes for the Euler Equations	248
M H CARPENTER: A High-Order Compact Numerical Algorithm for Supersonic Flows	254
H C YEE, P K SWEBY, D F GRIFFITHS: A Study of Spurious Asymptotic Numerical Solutions of Nonlinear Differential Equations by the Nonlinear Dynamics Approach	259
M MEINKE, D HÄNEL: Simulation of Unsteady Flows	268
P L ROE, H DECONINCK, R J STRUIJS: Recent Progress in Multi-Dimensional Upwinding	273
J LAMINIE, F PASCAL, R TEMAM: Nonlinear Galerkin Method with Finite Element Approximation	278
H WU, K OSHIMA: Three-Dimensional Highly Accurate MmB Schemes for Viscous, Compressible Flow Problems	283
P O'BRIEN, M G HALL: A Comparison of the Effects of Grid Distortion on Finite-Volume Methods for Solving the Euler Equations	287
J K DUKOWICZ, B J A MELTZ: Vorticity Errors in Multidimensional Lagrangian Codes	291

J P BORIS, E S ORAN, F F GRINSTEIN, E F BROWN, C LI, R KOLBE, R O WHALEY: Three Dimensional Large Eddy Simulations with Realistic Boundary Conditions Performed on a Connection Machine.....	297
D TROMEUR-DERVOUIT, L TA PHUOC, L MANE: A 3D Navier-Stokes Solver on Distributed Memory Multiprocessor.....	303
R W LELAND, J S ROLLETT: Parallel Extrapolation Methods for Computational Fluid Dynamics.....	308
L B WIGTON, R C SWANSON: Variable Coefficient Implicit Residual Smoothing.....	313
E S ORAN, J P BORIS, D A JONES: Reactive-Flow Computations on a Connection Machine.....	318
S YOON: Navier-Stokes Solvers Using Lower-Upper Symmetric Gauss-Seidel Algorithm.....	323
J CASPER: An Extension of Essentially Non-Oscillatory Shock-Capturing Schemes to Multi-Dimensional Systems of Conservation Laws.....	325
S-H CHANG: On a Modified ENO Scheme and Its Application to Conservation Laws with Stiff Source Terms.....	327
N CLARKE, D M INGRAM, D M CAUSON, R SAUNDERS: Convenient Entropy-Satisfying TVD Schemes with Applications.....	329
E DICK: Second Order Defect-Correction Multigrid Formulation of the Polynomial Flux-Difference Splitting Method for Steady Euler Equations.....	333
B ENGQUIST, B SJÖGREEN: Projection Shock Capturing Algorithms.....	335
P Å WEINERFELT: Multigrid Technique Applied to the Euler Equations on a Multi-Block Mesh.....	337
A J FORESTIER: Treatment of Inert and Reactive Flows by a TVD Formulation in 2D Space in Unstructured Geometry.....	339
K NAKAHASHI, K EGAMI: Unstructured Upwind Approach for Complex Flow Computations.....	342
L STOLCIS, L J JOHNSTON: Implementation of a High Resolution TVD Scheme for Compressible Inviscid Flow on Unstructured Grids.....	344

S T ZALESK: Generalized Finite Volume (GFV) Schemes on Unstructured Meshes: Cell Averages, Point Values, and Finite Elements	346
J LAVERY: Solution of Steady-State Conservation Laws by l_1 Minimization	348
C-C ROSSOW: Flux Balance Splitting — A New Approach for a Cell Vertex Upwind Scheme	350
R STRUIJS, H DECONINCK, P DE PALMA: Multidimensional Upwind Schemes Using Fluctuation Splitting and Different Wave Models for the Euler Equations	352
R M S M SCHULKES: Interactions of a Viscous Fluid with an Elastic Solid: Eigenmode Analysis	355
R C HALL, D J DOORLY: Parallel Solution Procedures for Transonic Flow Computations	357
L A BLINOVA, Yu E EGOROV, A E KUZNETSOV, M A ROTINIYAN, M Kh STRELETS, M L SHUR: Compressibility Scaling Method for Multidimensional Arbitrary Mach Number Navier-Stokes Calculations of Reactive Flows	359
C K LOMBARD, S K HONG, J BARDINA, J OLIGER, S SUHR, J CAPORALETTI, W H CODDING, D WANG: Simple, Efficient Parallel Computing with Asynchronous Implicit CFD Algorithms on Multiple Grid Domain Decompositions	361
D W FOUTCH, D R MCCARTHY: Validation of an Upwind Euler Solver	363
J SHI, D HITCHINGS: Finite Element Analysis of Airfoil Immersed in a Sinusoidal Gust	365
S A E G FALLE: Flame Capturing	367
C BASDEVANT, M HOLSCHNEIDER, J LIANDRAT, V PERRIER, Ph TCHAMITCHIAN: Numerical Resolution of the Burgers Equation Using the Wavelet Transform	369
B LI, M G SMITH, U T EHRENMARK, P S WILLIAMS: Application of Boundary Element Method to a Shallow Water Model	371
M O BRISTEAU, R GLOWINSKI, J PÉRIAUX, M RAVACHOL, Y XIANG: Stabilization of the Navier-Stokes Solutions via Control Techniques	373

N DÉBIT, Y MADAY: Approximation of the Stokes Problem with a Coupled Spectral and Finite Element Method.....	375
P M GOORJIAN, S OBAYASHI, G P GURUSWAMY: Streamwise Upwind Algorithm Development for the Navier-Stokes Equations.....	377
A DADONE, B GROSSMAN: A Domain of Dependence Upwind Scheme for the Euler Equations.....	379
B FAVINI, M DI GIACINTO: Numerical Approximation by Godunov-Type Schemes of Shocks and Other Waves.....	381
F E CANNIZZARO, A ELMILIGUI, N D MELSON, E VON LAVANTE: A Multiblock Multigrid Three-Dimensional Euler Equation Solver.....	385
F GRASSO, F BASSI, A HARTEN: ENO Schemes for Viscous High Speed Flows.....	387
Transonic, Supersonic and Hypersonic Flows	
M HAFEZ, J AHMAD: Design of Airfoils in Transonic Flows.....	389
P M HARTWICH: Split Coefficient Matrix (SCM) Method with Floating Shock Fitting for Transonic Airfoils.....	394
P K KHOSLA, T E LIANG, S G RUBIN: Supersonic Viscous Flow Calculations for Axisymmetric Configurations.....	400
Y TAMURA, K FUJII: Visualization Method for Computational Fluid Dynamics with Emphasis on the Comparison with Experiments.....	406
C MARMIGNON, H HOLLANDERS, F COQUEL: Navier-Stokes Calculations of Hypersonic Flow Configurations with Large Separation by an Implicit Non-Centered Method.....	411
S BORRELLI, M PANDOLFI: An Upwind Formulation for the Numerical Prediction of Non-Equilibrium Hypersonic Flows.....	416
F G BLOTTNER: Navier-Stokes Results for the Hypersonic Blunt Body Problem with Equilibrium Air Properties and with Shock Fitting.....	421
P LARDY, H DECONINCK: A Polynomial Flux Vector Splitting Applied to Viscous Hypersonic Flow Computation.....	426
M PFITZNER: Simulations of Inviscid Equilibrium and Nonequilibrium Hypersonic Flows.....	432

N SATOFUKA, K MORINISHI, Y SAKAGUCHI: Numerical Solutions of the Boltzmann Equation for Hypersonic Flows	437
N KROLL, C ROSSOW: A High Resolution Cell Vertex TVD Scheme for the Solution of the Two and Three Dimensional Euler Equations	442
C-H BRUNEAU, J LAMINIE: Computation of Hypersonic Flows Around Blunt Bodies and Wings.....	447
K D JONES, F C DOUGHERTY, H SOBIECZKY: Hypersonic Flows About Waveriders with Sharp Leading Edges	449
B MÜLLER: Upwind Relaxation Method for Hypersonic Flow Simulation	451
N QIN, B E RICHARDS: PNS Solution Using Sparse Quasi-Newton Method for Fast Convergence.....	453
M L SAWLEY, S WÜTHRICH: Numerical Simulation of Non-Equilibrium Hypersonic Flow Using the Second-Order Boundary Layer Equations.....	455
J B VOS, C M BERGMAN: Chemical Equilibrium and Non-Equilibrium Inviscid Flow Computations Using a Centered Scheme	457
S ASO, M HAYASHI: Numerical Simulations of Separated Flows Around Bluff Bodies and Wings by a Discrete Vortex Method Combined with Panel Method	459
M G MACARAEG, Q I DAUDPOTA: Numerical Studies of Transverse Curvature Effects on Compressible Flow Stability	461
L I TURCHAK: Conservative Schemes for Supersonic Flows with Internal Shocks.....	463
Propulsion Systems	
T L JIANG: The Flow Computation of a Liquid Rocket Engine Combustor of Complex Geometry	464
K NAITOH, K KUWAHARA, E KRAUSE: Computation of the Transition to Turbulence and Flame Propagation in a Piston Engine	469
S VENKATESWARAN, C L MERKLE: Coupled Navier-Stokes Maxwell Solutions for Microwave Propulsion	475

J FOŘT, M HUNĚK, K KOZEL, M VAVŘINCOVÁ: Comparison of Several Numerical Methods for Computation of Transonic Flows Through a 2D Cascade	480
S YAMAMOTO, H DAIGUJI: Numerical Simulation of Unsteady Turbulent Flow through Transonic and Supersonic Cascades	485
G FERNANDEZ, K Z TANG, H A DWYER: A Comparative Study of the Low Mach Number and Navier-Stokes Equations with Time-Dependent Chemical Reactions	490
S LECHERER, H-H FRUEHAUF: An Accurate and Fast 3-D Euler-Solver for Turbomachinery Flow Calculation	495
Z BAR-DEROMA, M WOLFSHTEIN: Computation of the Flow in Elliptical Ducts	497
Environmental Flows	
M H MAWSON, M J P CULLEN: A Fully Implicit Method for Solving the 3-Dimensional Quasi-Equilibrium Equations on the Sphere	499
S H MIGORSKI, R F SCHAEFER: The Existence Aspects of Dupuit and Boussinesq Filtration Models Using Finite Element Method	504
G L BROWNING, W R HOLLAND, S J WORLEY, H-O KREISS: An Accurate Hyperbolic System for Approximately Hydrostatic and Incompressible Oceanographic Flows	509
A F GHONIEM, H R BAUM, R G REHM: Vortex Simulation of Particulate Plume Dispersal and Settling	514
K D NGUYEN: A 3D Numerical Diagnostic Simulation for the General Circulation in the Gulf of Lion (France)	516
Mesh Generation and Adaption	
R TILCH: Unstructured Grids, Adaptive Remeshing and Mesh Generation for Navier-Stokes	519
M J BOCKELIE, P R EISEMAN, R E SMITH: A General Purpose Time Accurate Adaptive Grid Method	524
S CHIBA, K KUWAHARA: A Finite Difference Formulation for Free Surface Flow Problems Using a Free Surface Conforming Grid System	529

N MAMAN, B LARROUTUROU: On the Use of Dynamical Finite-Element Mesh Adaptation for 2D Simulation of Unsteady Flame Propagation.....	534
B PALMERIO, A DERVIEUX: On Weak and Strong Coupling Between Mesh Adaptors and Flow Solvers	540
H TAKEDA, C-Z HSU: A Finite-Difference Method for Incompressible Flows Using a Multi-Block Technique.....	545
S L KABALKIN: Effective Method for Calculation of Gas Flow About Blunt Bodies in a New Approach to Constructing Three-Dimensional Grids....	550
J J QUIRK: An Adaptive, Embedded Mesh Refinement Algorithm for the Euler Equations.....	552
K SAWADA: Numerical Simulation of Flows over Complete Aircraft Using Block Structured Grid Systems.....	554
R LÖHNER, J D BAUM: Further Algorithmic Improvements of Adaptive H-Refinement for 3-D Transient Problems.....	556
AUTHOR INDEX	559