

Adaptive Structures

Papers Presented at the AIAA SciTech Forum and Exposition
2021

Online
11-15 & 19-21 January 2021

Volume 1 of 6

ISBN: 978-1-7138-2615-6

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

The contents of this work are copyrighted and additional reproduction in whole or in part are expressly prohibited without the prior written permission of the Publisher or copyright holder. The resale of the entire proceeding as received from CURRAN is permitted.

For reprint permission, please contact AIAA's Business Manager, Technical Papers. Contact by phone at 703-264-7500; fax at 703-264-7551 or by mail at 34922 Uwytkug'Xcmg{'Ftkxg.'Uwky'422, Reston, VA 20191, USA.

TABLE OF CONTENTS

VOLUME 1

LINEAR STABILITY

LINEAR INSTABILITY MECHANISMS OF SUPERSONIC FLOW PAST BLUNT BODIES	1
<i>Anton Burtsev, Helio Ricardo D. Quintanilha, Vassilios Theofilis, Ricardo D. Santos, Leonardo S. Alves</i>	
SHOCK DRIVEN KELVIN-HELMHOLTZ INSTABILITY	11
<i>Brian E. Romero, Svetlana Poroseva, Peter Vorobieff, Jon Reisner</i>	
GLOBAL LINEAR STABILITY ANALYSIS OF THE SUPERSONIC FLOWS OVER A HOLLOW CYLINDER FLARE MODEL	26
<i>Nicolas Cerulus, Helio Quintanilha, Vassilios Theofilis</i>	

CFD METHODS I

CALIBRATING THE CHEMICAL-DIFFUSIVE MODEL USING THE DETONATION CELL DATA	40
<i>Xiaoyi Lu, Carolyn R. Kaplan, Elaine S. Oran</i>	
A ROBUST EXPLICIT ASYNCHRONOUS TIME INTEGRATION METHOD FOR HYPERBOLIC CONSERVATION LAWS	49
<i>Ramzi Messahel, Athanasios Boutsikakis, Gilles Grondin, Jérémie Gressier, Matteo Parsani, Radouan Boukharfane</i>	
DEVELOPMENT OF A GPU-ENABLED HIGH-ORDER FLUX RECONSTRUCTION SOLVER FOR HIGH-SPEED FLOWS	70
<i>Ray Vandenhoek, Andrea Lani</i>	
RESOLVING CONFUSION OVER THIRD-ORDER ACCURACY OF U-MUSCL	84
<i>Emmett Padway, Hiroaki Nishikawa</i>	

HYPERSONIC AND NON-EQUILIBRIUM FLOWS I

INFLUENCE OF CHEMICAL KINETICS MODELS ON PLASMA GENERATION IN HYPERSONIC FLIGHT	110
<i>Pawel Sawicki, Ross S. Chaudhry, Iain D. Boyd</i>	
NUMERICAL ANALYSIS OF SHOCK SPEED ATTENUATION IN EXPANSION TUBE	126
<i>Hiroki Sakamoto, Shintaro Sato, Naofumi Ohnishi</i>	

WALL-BOUNDED TURBULENT FLOWS I

WALL-MODELED LARGE-EDDY SIMULATIONS OF LOW-SPEED FLOWS WITH HEAT TRANSFER	134
<i>Xiang I. Yang, Haosen Xu, Pedro Milani</i>	

STATISTICS OF TURBULENT BOUNDARY LAYERS COMPUTED BY LES OF A NACA0012 AIRFOIL	150
<i>Gabriel Nogueira, Tulio Rodarte Ricciardi, William Wolf</i>	

A UNIVERSAL VELOCITY PROFILE FOR NEAR-WALL FLOWS	163
<i>Matthew Subrahmanyam, Brian J. Cantwell, Juan J. Alonso</i>	

DEVELOPMENT OF WALL MODELING FRAMEWORK IN A HIGH-ORDER SPECTRAL ELEMENT CFD SOLVER NEK5000	182
<i>Pinaki Pal, Muhsin M. Ameen, Chao Xu</i>	

EXPERIMENTS IN INSTABILITY AND TRANSITION

HYPERSONIC SECOND MODE INSTABILITY RESPONSE TO SHAPED ROUGHNESS	188
<i>Andrew Leidy, Rudolph King, Meelan M. Choudhari, Pedro Paredes</i>	

CFD ANALYSIS OF BOUNDARY LAYER TRANSITION BY PASSIVE TRIPPING	216
<i>Shawn Aram, Hua Shan, Li Jiang</i>	

MEASUREMENTS OF FREESTREAM FLUCTUATIONS IN THE LANGLEY RESEARCH CENTER UNITARY PLAN WIND TUNNEL.....	233
<i>Amanda Chou, Andrew Leidy, Matthew N. Rhode</i>	

EXPERIMENTAL INVESTIGATION ON RECEPTIVITY OF CROSSFLOW INSTABILITY TO DISCRETE ROUGHNESS AMPLITUDE AND LOCATION	256
<i>Giulia Zoppini, Daniele Ragni, Marios Kotsonis</i>	

EXPERIMENTAL MEASUREMENTS OF HYPERSONIC INSTABILITIES OVER OGIVE- CYLINDERS AT MACH 6	271
<i>Jonathan L. Hill, Ryan A. Oddo, Jeffrey R. Komives, Mark F. Reeder, Matthew P. Borg, Joseph S. Jewell</i>	

CFD METHODS II

RADIO COMMUNICATION BLACKOUT ANALYSIS OF EXOMARS RE-ENTRY MISSION USING RAYTRACING METHOD.....	292
<i>Vincent F. Giangaspero, Andrea Lani, Stefaan Poedts, Jan Thoemel, Alessandro Munafò</i>	

ACCELERATION OF ADJOINT-BASED ADAPTATION THROUGH SUB-ITERATIONS FOR UNSTEADY SIMULATIONS.....	308
<i>Kaihua Ding, Krzysztof Fidkowski</i>	

HIGH-ORDER SPACE-TIME DISCONTINUOUS GALERKIN DISCRETIZATION USING TENSOR-PRODUCT FORMULATIONS	327
<i>Sung-Hwan Yoon, Dimitri Mavriplis</i>	

A RANS APPROACH TO SUPERCRITICAL CO2 SINGLE-JET IMPINGEMENT AT ULTRA- HIGH REYNOLDS NUMBERS.....	350
<i>Ian J. Cormier, Andres Curbelo, Akshay Khadse, Jayanta Kapat</i>	

HYPersonic AND NON-EQUILIBRIUM FLOWS II

NUMERICAL SIMULATION OF VISCOUS EFFECTS ON HIGH ENTHALPY FLOW OVER A DOUBLE-WEDGE GEOMETRY	368
<i>Shankar Ghosh, Prakash Thirunavukkarasu</i>	
IMPLICIT THERMOCHEMICAL NONEQUILIBRIUM FLOW SIMULATIONS ON UNSTRUCTURED GRIDS USING GPUS	380
<i>Gabriel Nastac, Aaron Walden, Eric J. Nielsen, Kader Frendi</i>	

WALL-BOUNDED TURBULENT FLOWS II

PROGRESS IN THE DEVELOPMENT OF AN IMMersed BOUNDARY VISCOUS-WALL MODEL FOR 3D AND HIGH-SPEED FLOWS	405
<i>Sparsh Ganju, William Van Noordt, Christoph Brehm</i>	
LARGE EDDY SIMULATION OF FLOW AND HEAT TRANSFER OVER FORWARD-FACING STEPS WITH UPSTREAM INJECTION	417
<i>Jayant Rao, Stephen P. Lynch</i>	
ON THE NATURE OF FREESTREAM DISTURBANCES IN A TWO-DIMENSIONAL SUPERSONIC TEST SECTION	437
<i>Chitrarth Prasad, Junji Huang, Lian Duan, Datta V. Gaitonde</i>	

CFD METHODS III

ASSESSMENT OF PROJECTION-BASED REDUCED-ORDER MODELING STRATEGIES FOR UNSTEADY FLOWS	453
<i>Victor Zucatti, William Wolf</i>	
PERFORMANCE ANALYSIS OF A PROPOSED DESIGN OF DIVERTERLESS SUPERSONIC INLET AT VARIOUS FLIGHT CONDITIONS	470
<i>Abdul Ahad Afzal, Muhammad Muneeb Safdar, Ali Javed</i>	
A FLUX RECONSTRUCTION MODEL BASED ON AN ARTIFICIAL NEURAL NETWORK	478
<i>Seongmun Jung, Oh Joon Kwon</i>	
COMPUTATIONAL FLUID DYNAMICS INVESTIGATIONS OF A THRUST REVERSER UNIT FLOWFIELD	489
<i>Houda Bdeiwi, Andrea Ciarella</i>	

HYPersonic AND NON-EQUILIBRIUM FLOWS III

SEPARATION BUBBLE VARIATION DUE TO SMALL ANGLES OF ATTACK FOR AN AXISYMMETRIC MODEL AT MACH 6	510
<i>Elizabeth K. Benitez, Joseph S. Jewell, Steven P. Schneider</i>	
INVESTIGATION OF HYPersonic FLOW AROUND A HALF CIRCULAR CYLINDER USING COUPLED FLOW-THERMAL ANALYSIS	533
<i>Yusuke Mizuno, Shun Takahashi, Gouji Yamada</i>	

INSTABILITY AND TRANSITION I

- AN EXPERIMENTAL STUDY OF THE EFFECTS OF SURFACE ROUGHNESS ON THE LAMINAR-TURBULENT TRANSITION OF A 2D INCOMPRESSIBLE BOUNDARY-LAYER 539
Felix Ducaffy, Maxime Forte, Olivier Vermeersch, Estelle Piot
- IDENTIFICATION OF TRANSIENT MODES DURING FORMATION AND DETACHMENT OF A LAMINAR SEPARATION BUBBLE USING KERNEL MODE DECOMPOSITION 555
Tso-Kang Wang, Kourosh Shoele
- INSTABILITY AND TRANSITION ON A CONE WITH A SLICE AND RAMP AT MACH 6 567
Gregory McKiernan, Steven P. Schneider

FLUID STRUCTURE INTERACTION

- NUMERICAL STUDY OF STBLI ON FLEXIBLE PANELS WITH WALL-MODELED LES 595
Jonathan F. Hoy, Ivan Bermejo-Moreno
- INVESTIGATION OF FLEXIBLE PANEL DYNAMIC RESPONSE INDUCED BY COHERENT TURBULENT VORTICAL STRUCTURES 615
Anup Zope, Colby Horner, Eric M. Collins, Shanti Bhushan, Manav Bhatia

CFD METHODS IV

- IMPLEMENTATION OF AN EFFICIENT SELECTIVE FREQUENCY DAMPING METHOD IN A RANS SOLVER 648
Vincent Liguori, Frédéric Plante, Eric Laurendeau
- ADJOINT-BASED ERROR ESTIMATION FOR GRID ADAPTATION FOR LARGE EDDY SIMULATION 661
Yao Jiang, Sivakumaran Nadarajah
- A FORMAL EVALUATION OF A CONSISTENT AVERAGING PROCEDURE FOR SOLVING THE TIME-DEPENDENT NAVIER STOKES EQUATIONS NUMERICALLY 686
Julio C. Mendez, Michael D. Atkinson, Mookesh Dhanasar, Frederick Ferguson

FLUID STRUCTURE INTERACTION MODELING

- PRESSURE FLUCTUATION LONGITUDINAL COHERENCE: AN EXTENDED MODEL 704
Lawrence J. Dechant, Katya M. Casper
- THICK STRIP METHOD FOR EFFICIENT LARGE-EDDY SIMULATIONS OF FLEXIBLE WINGS IN STALL 720
Mohsen Lahooti, Rafael Palacios, Spencer J. Sherwin

VOLUME 2

- MODE BASED REDUCED ORDER MODEL FOR A MOVING STORE 740
Nicholas Peters, John A. Ekaterinaris, Andrew M. Wissink

IMPROVED DELAYED DETACHED EDDY SIMULATION OF AGARD WING FLUTTER WITH FULLY COUPLED FLUID-STRUCTURE INTERACTION.....	778
<i>Purvic Patel, Gecheng Zha</i>	

INSTABILITY AND TRANSITION II

HYPERSONIC SIMULATIONS OF THE BOLT-II SUBSCALE GEOMETRY.....	794
<i>Zachary M. Johnston, Graham V. Candler</i>	
NUMERICAL INVESTIGATION OF FLOW INSIDE THE COLLECTOR OF A SOLAR CHIMNEY POWER PLANT.....	808
<i>Md Kamrul Hasan, Andreas Gross, Ladan Bahrainirad, Hermann F. Fasel</i>	

HYPERSONIC AND NON-EQUILIBRIUM FLOWS IV

DIRECT NUMERICAL SIMULATION OF BOUNDARY LAYER RECEPTIVITY TO ACOUSTIC RADIATION IN A HYPERSONIC COMPRESSION RAMP FLOW.....	820
<i>Fabian Dettenrieder, Bryson T. Sullivan, Antonio Giovanni Schöneich, Stuart J. Laurence, Daniel J. Bodony</i>	
FOCUSED LASER DIFFERENTIAL INTERFEROMETRY COMBINED WITH SCHLIEREN ON HYPERSONIC HOLLOW CYLINDER FLARE AND HOLLOW CYLINDER CONFIGURATIONS.....	836
<i>Jack W. Cobourn, John D. Schmisser</i>	

HIGH-SPEED FLUID STRUCTURE INTERACTION

VISCOUS EFFECTS ON PANEL FLUTTER IN HYPERSONIC FLOWS.....	863
<i>Bing Zhang, Yuejun Shi, Hui Xu, Linli Xie</i>	
SHOCK WAVE TURBULENT BOUNDARY LAYER INTERACTION OVER A FLEXIBLE PANEL.....	874
<i>Vilas J. Shinde, Jack J. McNamara, Datta V. Gaitonde</i>	
RESPONSE OF A COMPLIANT PANEL TO SHOCK BOUNDARY LAYER INTERACTION AT MACH 2.....	893
<i>Akriti Tripathi, Jonas Gustavsson, Kouros Shoele, Rajan Kumar</i>	
FREE INTERACTION IN THREE-DIMENSIONAL, LAMINAR SHOCKWAVE/BOUNDARY- LAYER INTERACTION.....	908
<i>Jiss J. Sebastian, Frank K. Lu</i>	

HYPERSONIC AND NON-EQUILIBRIUM FLOWS V

INVESTIGATION OF THERMODYNAMIC NON-EQUILIBRIUM IN HYPERSONIC FLOWS OVER THE MARS PATHFINDER CAPSULE.....	919
<i>Farney C. Moreira, William Wolf, Joao Luiz F. Azevedo</i>	
AEROHEATING MEASUREMENT OF HAYABUSA-CAPSULE USING HEK-X EXPANSION TUBE.....	935
<i>Sho Fukumaru, Kohei Shimamura, Yusuke Fujiwara, Hideyuki Tanno, Kazuhiko Yamada</i>	

A NUMERICAL STUDY OF THERMAL NONEQUILIBRIUM AND HIGH-DENSITY EFFECTS ON THE VKI LONGSHOT CONTOURED NOZZLE.....	945
<i>Amna Khraibut, Olivier Chazot, Thierry Magin, Sudhir Gai</i>	

NOVEL CFD METHODS

TOWARDS A SCALABLE HIERARCHICAL HIGH-ORDER CFD SOLVER	976
<i>Zan Xu, Léopold Cambier, Juan J. Alonso, Eric Darve</i>	

SIMULATION OF TURBULENT FLOWS USING A FULLY DISCRETE EXPLICIT HP-NONCONFORMING ENTROPY STABLE SOLVER OF ANY ORDER ON UNSTRUCTURED GRIDS.....	990
<i>Matteo Parsani, Radouan Boukharfane, Irving E. Reyna Nolasco, Lisandro Dalcin, David E. Keyes</i>	

SHOCK CAPTURING METHODS IN HIGH-ORDER FLUX RECONSTRUCTION I: GRAPH VISCOSITY AND CONVEX LIMITING APPROACHES	1013
<i>Will Trojak, Tarik Dzanic, Freddie Witherden</i>	

INSTABILITY AND TRANSITION III

BI-GLOBAL LINEAR STABILITY ANALYSIS OF LAMINAR SEPARATION BUBBLE FOR HELICOPTER BLADE SECTION UNDERGOING DYNAMIC STALL.....	1037
<i>Guangwei Wen, Andreas Gross</i>	

SIMULATIONS OF DYNAMIC SHOCK WAVE/BOUNDARY LAYER INTERACTIONS USING HPCMP CREATETM-AV KESTREL COFFE	1061
<i>Nicole F. Nutter, Jack W. Cobourn, Ryan B. Bond, Phillip A. Kreth, John D. Schmisser, Ryan S. Glasby, Douglas L. Stefanski, Ethan Hereth, James G. Coder</i>	

NUMERICAL METHODS FOR STABILITY AND TRANSITION

ON THE CALIBRATION OF THE TRANSITIONAL K-?-?-RE?T TURBULENCE MODEL.....	1075
<i>Benjamin Barrouillet, Eric Laurendeau, Hong Yang</i>	

TRANSITION PREDICTION FOR FLOWS WITH SUCTION USING THE EN-METHOD	1087
<i>Normann Krimmelbein, Andreas Krumbein</i>	

SPATIAL TRANSITION POINT FROM LAMINAR FLOW TO TURBULENCE IN A CIRCULAR PIPE WITH BELLMOUTH INLET BY SOLVING A WEAKLY-STOCHASTIC NAVIER-STOKES EQUATION	1106
<i>Hiroki Kijima, Ken Naitoh, Tomotaka Kobayashi, Yuya Yamashita</i>	

STEADY LAMINAR SOLUTIONS OF HYPERSONIC FLOW OVER OBERKAMPF BODIES AT CRUISE	1118
<i>Helio Quintanilha, Vassilios Theofilis</i>	

CFD METHODS V

OPTIMIZED EXPLICIT RUNGE-KUTTA SCHEMES FOR ENTROPY STABLE DISCONTINUOUS COLLOCATED METHODS APPLIED TO THE EULER AND NAVIER-STOKES EQUATIONS	1126
<i>Rasha Al Jahdali, Radouan Boukharfane, Lisandro Dalcin, Matteo Parsani</i>	

ENTROPICALLY DAMPED ARTIFICIAL COMPRESSIBILITY SOLVER USING HIGHER ORDER FINITE DIFFERENCE SCHEMES ON CURVILINEAR AND DEFORMING MESHES	1148
<i>Shankar Achu, Nagabhushana Rao Vadlamani</i>	

MULTI-PHASE FLOWS I

LARGE EDDY SIMULATION OF TURBULENT PARTICLE-LADEN JETS USING THE SPECTRAL ELEMENT METHOD	1160
<i>Juan D. Colmenares, Muhsin M. Ameen, Sicong Wu, Saumil Patel</i>	

LARGE-EDDY SIMULATION OF TWO-PHASE FLOW IN AIR-SPARGED HYDROCYCLONE	1184
<i>Mustafa Bukhari, Hassan Fayed, Saad A. Ragab</i>	

STABILITY AND TRANSITION OVER CONICAL GEOMETRIES

NUMERICAL STUDY OF THE RECEPTIVITY OF A BLUNT CONE TO HYPERSONIC FREESTREAM PULSE DISTURBANCES	1207
<i>Simon He, Xiaolin Zhong</i>	

DIRECT NUMERICAL SIMULATIONS OF HYPERSONIC BOUNDARY-LAYER TRANSITION FOR A STRAIGHT CONE AT MACH 5	1237
<i>Christoph Hader, Ning Deng, Hermann F. Fasel</i>	

DIRECT NUMERICAL SIMULATIONS OF LAMINAR-TURBULENT BOUNDARY-LAYER TRANSITION FOR A BLUNT CONE AT MACH 6	1259
<i>Andrew Hartman, Christoph Hader, Hermann F. Fasel</i>	

CFD METHODS VI

TIME INTEGRATION CONSIDERATIONS FOR THE SOLUTION OF REACTING FLOWS USING DISCONTINUOUS GALERKIN METHODS	1272
<i>Brett J. Bornhoft, Eric J. Ching, Matthias Ihme</i>	

FINITE-DIFFERENCE CARTESIAN CUT-CELL METHOD FOR HYPERBOLIC SYSTEMS	1284
<i>Nek Sharan, Peter T. Brady, Daniel Livescu</i>	

ADAPTIVE MESH REFINEMENT FOR A SHARP IMMERSSED BOUNDARY METHOD	1308
<i>John C. Higgins, Oliver M. Browne, Christoph Brehm</i>	

OTHER TOPICS IN FLUID DYNAMICS

DEVELOPMENT OF PARALLEL CFD APPLICATIONS WITH THE CHAPEL PROGRAMMING LANGUAGE.....	1329
<i>Mathieu Parenteau, Simon Bourgault-Cote, Frédéric Plante, Engin Kayraklioglu, Eric Laurendeau</i>	

INVESTIGATING THE UNSTEADY FLUID PHYSICS WITHIN COMPLEX FLOWS FIELDS.....	1345
<i>Frederick Ferguson, Yang Gao, Dehua Feng, Michael D. Atkinson, Julio C. Mendez</i>	

MULTI-PHASE FLOWS II

EVALUATION OF DROPLET AERODYNAMIC BREAKUP MODELS IN SUPERSONIC AND HYPERSONIC FLOWS	1367
<i>Andrew Hess, David A. Kessler, Ryan F. Johnson, Camilo Aguilera, Jonathan Sosa, Gabriel B. Goodwin</i>	
CRATERING IN A GRANULAR BED DUE TO AN IMPINGING SUPERSONIC JET PENETRATING A PLANETARY ATMOSPHERE IN THE CONTINUUM REGIME	1382
<i>Kaushik Balakrishnan, Josette R. Bellan</i>	
STRUCTURES OF DIESEL WITH DISSOLVED GAS IN SUPERSONIC CROSSFLOW	1410
<i>Travis Tidball, Kuo-Cheng Lin, Stephen Hammack, Timothy Ombrello</i>	
THE SHOCK-INDUCED DISPERAL OF DENSE PARTICLE CURTAINS WITH VARYING DENSITY	1423
<i>Kyle Daniel, Paul Farias, Justin L. Wagner</i>	

BIO-INSPIRED FLIGHT I

INVESTIGATING THE EFFECT OF AN UPSTREAM SPHEROID ON TANDEM HYDROFOIL PERFORMANCE.....	1432
<i>Joel T. Guerra, Graham Doig</i>	
EFFECT OF AIRFOIL-PRESERVED UNDULATIONS ON FREE SHEAR LAYER.....	1454
<i>Faith A. Loughnane, Michael P. Mongin, Sidaard Gunasekaran</i>	

VOLUME 3

HEATED BOUNDARY LAYER AND AERODYNAMIC EFFICIENCY OF AIRFOILS: BIRDS COLORATION AND BIOINSPIRATION.....	1472
<i>Ahmed Aboelezz, Zachary Rubin, Mostafa Hassanalian</i>	

MULTI-PHASE FLOWS III

EXPLORATION OF TWO-PHASE FLOW STRUCTURES IN METAL NOZZLES WITH VARIOUS CONFIGURATIONS USING X-RAY FLUORESCENCE TECHNIQUES	1480
<i>Kuo-Cheng Lin, Alan Kastengren, Campbell D. Carter</i>	
TURBULENT DISPERSION AND DEPOSITION OF MICRON-SIZED PARTICLES IN A TURBULENT PIPE FLOW AT HIGH TEMPERATURES.....	1492
<i>Pritheesh Gnanaselvam, Chi Hsiu Lo, Jiaxuan Han, Jeffrey P. Bons</i>	

INSTABILITY AND TRANSITION IV

THE MACK'S AMPLITUDE METHOD REVISITED	1513
<i>Alexander Fedorov, Anatoli Tumin</i>	
ANALYSIS OF THE BOLT II - HOLDEN MISSION FLIGHT AND WIND TUNNEL GEOMETRIES.....	1531
<i>Charles D. Mullen, Helen L. Reed</i>	

EFFECT OF LOCALIZED WALL COOLING OR HEATING ON STREAKS IN HIGH-SPEED BOUNDARY LAYERS	1545
<i>Omar Es-Sahli, Adrian Sescu, Mohammed Z. Afsar, Yuji Hattori, Makoto Hirota</i>	

MECHANISMS OF INTERACTION BETWEEN STATIONARY CROSSFLOW INSTABILITIES AND FORWARD-FACING STEPS	1561
<i>Jordi Casacuberta, Stefan Hickel, Marios Kotsonis</i>	

CFD METHODS VII

SUSTAINABLE HIGH-PERFORMANCE OPTIMIZATIONS IN SU2	1591
<i>Pedro Gomes, Thomas D. Economon, Rafael Palacios</i>	

A VERTEX-CENTERED FINITE VOLUME METHOD WITH SHARP INTERFACE CAPTURING FOR COMPRESSIBLE TWO-PHASE FLOWS	1609
<i>Lingquan Li, Rainald Lohner, Aditya Pandare, Hong Luo</i>	

IMPROVEMENTS IN ITERATIVE CONVERGENCE OF FUN3D SOLUTIONS	1626
<i>Li Wang, Boris Diskin, Eric J. Nielsen, Yi Liu</i>	

LARGE-EDDY-SIMULATIONS OF THE UNSTEADY BEHAVIOUR OF A MACH 5 HYPERSONIC INTAKE	1648
<i>Francesco De Vanna, Francesco Picano, Ernesto Benini</i>	

BIO-INSPIRED/LOW REYNOLDS NUMBER FLOWS

EFFECTS OF VEIN STRUCTURES ON FLUID-STRUCTURE INTERACTION OF FLEXIBLE FLAPPING WINGS AT HIGH ALTITUDES	1658
<i>Madhu Sridhar, Jeremy A. Pohly, Chang-Kwon Kang, D Brian Landrum, Taeyoung Lee, Hikaru Aono</i>	

COMPUTATIONAL STUDY ON THE EFFECTS OF UNSTEADY FREESTREAM ON AN AIRFOIL PERFORMANCE AT LOW REYNOLDS NUMBERS	1675
<i>Naresh Poudel, Meilin Yu, John T. Hrynuk</i>	

INSTABILITY AND TRANSITION V

STABILITY ANALYSIS OF THE FLOW OVER A SWEPT FORWARD-FACING STEP USING PIV BASE FLOWS	1691
<i>Koen J. Groot, Jenna L. Eppink</i>	

PARTICLE-IMPINGEMENT SIMULATIONS FOR A BLUNT CONE IN HYPERSONIC FLOW	1708
<i>Vincenzo Russo, Sayed Mohammad Abdullah Al Hasnine, Christoph Brehm</i>	

CFD METHODS VIII

SIMULATIONS OF A PLUNGING AIRFOIL UNDERGOING UNEQUAL ASCENDING AND DESCENDING VELOCITIES AT LOW REYNOLDS NUMBERS	1721
<i>George L. Torres, Emanuel A. Camacho, Flavio D. Marques, Andre R. Silva</i>	

OVERVIEW OF VALIDATION COMPLETENESS FOR GAUSSIAN SPEED-BUMP SEPARATED FLOW EXPERIMENTS	1733
<i>Matthew L. Robbins, Madeline Samuell, Hariprasad Annamalai, Owen J. Williams</i>	

NON-CLASSICAL ISENTROPIC FLOW BEHAVIOR OF A BETHE-ZEL' DOVICH-THOMPSON GAS	1756
<i>Jingyi Zeng, Jie Zhu, Feng Liu</i>	

BIO-INSPIRED FLIGHT II

OPTIMAL GAITS OF FISH-LIKE SWIMMING	1784
<i>Xuanhong An, Daniel Floryan, Clarence W. Rowley</i>	
UNSTEADY VORTICITY FORCE DECOMPOSITION - EVALUATING GUST DISTORTION	1795
<i>Pascal Gehler, Ignacio Andreu Angulo, Holger Babinsky</i>	
EFFECTS OF CHORDWISE OR SPANWISE NON-UNIFORM STIFFNESS ON PROPULSIVE PERFORMANCE OF SQUARE FOIL	1818
<i>Ruijie Zhu, Junshi Wang, Haibo Dong, Hilary Bart-Smith</i>	
PERMEABLE MEMBRANE WING CHARACTERISTICS AT REYNOLDS NUMBER ORDER OF 10,000	1825
<i>Koji Fujita, Koichi Takahashi, Hiroki Nagai</i>	

VORTEX DYNAMICS I

EXPERIMENTS ON HELICAL VORTEX PAIRS IN THE WAKE OF A ROTOR	1835
<i>Dominic Schröder, Thomas Leweke, Ralf Hörnschemeyer, Eike Stumpf</i>	
ASPECT RATIO EFFECT ON FINITE WING DYNAMIC STALL	1852
<i>Patrick R. Hammer, Daniel J. Garmann, Miguel Visbal</i>	
EVALUATING THE PASSAGE VORTEX RESPONSE TO UPSTREAM PERIODIC UNSTEADINESS	1873
<i>Mitchell Scott, Christopher R. Marks, Mitch Wolff</i>	
EXPERIMENTAL INVESTIGATION OF DOWNBURSTS IN A CROSSFLOW	1891
<i>Skyler Jacob, Garrett Clay, Jandreau Jackson, Jamey D. Jacob</i>	

INSTABILITY AND TRANSITION VI

INTERACTION OF SECOND-MODE DISTURBANCES AND 3-D ROUGHNESS ON A COOLED FLARED CONE AT MACH 6	1903
<i>Farhan Siddiqui, William S. Saric, Rodney D. Bowersox</i>	
ANALYSIS OF THE BOLT FLIGHT GEOMETRY AT OFF-NOMINAL CONDITIONS	1915
<i>Charles D. Mullen, Helen L. Reed</i>	
A PARALLELIZABLE MATHEMATICAL FRAMEWORK FOR LINEARIZED ANALYSIS OF FLOWS IN THE PRESENCE OF π -PERIODIC STRUCTURES	1936
<i>Athanasios T. Margaritis, Taraneh Sayadi, Olaf Marxen, Peter J. Schmid</i>	

CFD METHODS IX

AN EXPERIMENTAL AND NUMERICAL INVESTIGATION OF RESEARCH SIMPLEX ATOMIZER SPRAYS	1947
<i>Gabriel L. Jacobsohn, Brandon Sforzo, Alan Kastengren, Aniket Tekawade, Christopher F. Powell, Scott B. Leask, Alice K. Li, Vincent G. McDonell</i>	

SPATIO-TEMPORAL DATA RECONSTRUCTION ANALYSIS VIA KERNEL-BASED PROPER ORTHOGONAL DECOMPOSITION	1958
<i>Rebeca P. Marcondes, Tulio Rodarte Ricciardi, William Wolf</i>	

DYNAMIC MODE DECOMPOSITION OF A HIGHLY CONFINED SHOCK- WAVE/BOUNDARY-LAYER INTERACTION	1973
<i>Akshay S. Deshpande, Jonathan Poggie</i>	

TRANSITION CONTROL IN HIGH-SPEED FLOWS

PRELIMINARY COMPUTATIONAL STUDY OF TRANSITION ON A FLARED CONE USING RANDOM FORCING	1990
<i>Andrew J. Shuck, Jonathan Poggie, Gregory A. Blaisdell</i>	

DESIGN OF A HYPERSONIC BOUNDARY LAYER TRANSITION CONTROL EXPERIMENT UTILIZING A SWEPT FIN CONE GEOMETRY IN MACH 6 FLOW	2000
<i>John B. Middlebrooks, Emma Farnan, Eric H. Matlis, Thomas C. Corke, Charles D. Mullen, Madeline McMillan, Helen L. Reed</i>	

FLOW CONTROL USING STEADY BLOWING AND SUCTION STRIPS IN A MACH 6 BOUNDARY LAYER ON A FLARED CONE	2019
<i>Christoph Hader, Hermann F. Fasel</i>	

A COMPUTATIONAL ANALYSIS OF BOUNDARY LAYER INSTABILITY OVER THE BOLT CONFIGURATION	2040
<i>Meelan M. Choudhari, Fei Li, Pedro Paredes</i>	

OTHER TOPICS IN CFD

EXPERIENCES PORTING A HIGH ORDER CARTESIAN FINITE DIFFERENCE SOLVER TO GPUS USING OPENACC	2060
<i>Alejandro Figueroa, Rainald Lohner</i>	

LARGE EDDY SIMULATIONS OF TURBULENT CHANNEL FLOWS USING SPLIT FORM DG SCHEMES	2074
<i>Eron T. Dauricio, Joao Luiz F. Azevedo</i>	

VORTEX DYNAMICS II

DYNAMIC STALL OVER A PITCHING NATURAL-LAMINAR-FLOW AIRFOIL	2089
<i>Patrick R. Hammer, Daniel J. Garmann, Miguel R. Visbal</i>	

THREE-DIMENSIONAL INSTABILITIES OF VORTICES ON A PERIODICALLY PLUNGING WING	2110
<i>Onur Son, Zhijin Wang, Ismet Gursul</i>	

THREE-DIMENSIONAL SEPARATION OVER LOW ASPECT RATIO CANTILEVERED WINGS.....	2121
<i>Jacob Neal, Michael Amitay</i>	

FLOW CONTROL

AN EMPIRICAL PLATFORM FOR OPTIMAL PLACEMENT OF OPEN-LOOP MICROJET-IN-CROSSFLOW ACTUATORS.....	2133
<i>Fernando Zigunov, Prabu Sellappan, Farrukh S. Alvi</i>	

EXPERIMENTS AND SIMULATIONS OF A PROPULSIVE ROTOR WITH SYNTHETIC JETS FOR AERODYNAMIC PERFORMANCE ENHANCEMENT.....	2147
<i>Nicolas Peralta, Logan Boyd, Serdar Gorumlu, Victor Maldonado</i>	

TRANSPIRATION PRESSURE LOSS AND SUCTION THRESHOLD ON A FLAT-PLATE EMPLOYING BOUNDARY LAYER SUCTION.....	2160
<i>Adarsh Prasannakumar, Michelangelo Corelli Grappadelli, Arne Seitz, Camli Badrya</i>	

VOLUME 4

EFFECT OF OFF-AXIS PULSED ENERGY DEPOSITION ON THE KINZHAL MISSILE.....	2191
<i>Parth A. Laad, Doyle D. Knight</i>	

EXPERIMENTAL AERODYNAMICS

FLOW STRUCTURE AND HEAT TRANSFER CHARACTERIZATION OF A BLUNT-FIN-INDUCED SHOCK-WAVE/LAMINAR BOUNDARY-LAYER INTERACTION.....	2220
<i>Jorge Castro Maldonado, James A. Threadgill, Stuart A. Craig, Jesse C. Little, Stefan H. Wernz</i>	

CHARACTERIZATION OF THE AERODYNAMICS OF RECTANGULAR CYLINDERS WITH SURFACE TOPOLOGY.....	2239
<i>Kian Kalan, Alireza Safaripour, Ahmed M. Naguib, Manoochehr M. Koochesfahani</i>	

NUMERICAL AND EXPERIMENTAL INVESTIGATIONS OF ENERGY HARVESTING FROM PIEZOELECTRIC INVERTED FLAGS.....	2255
<i>Oluwafemi Ojo, Kourosh Shoele, Alper Erturk, Yu-Cheng Wang, Eetu Kohtanen</i>	

LOW-FREQUENCY UNSTEADINESS IN PRESSURE-INDUCED SEPARATION BUBBLES.....	2267
<i>Julien Weiss, Jesse C. Little, James A. Threadgill, Andreas Gross</i>	

CFD APPLICATIONS I

INVESTIGATION OF ATMOSPHERIC TURBULENCE AND SHOCK INTERACTION FOR A HYPERSONIC SPHERE-CONE.....	2286
<i>Luke J. Melander, Graham V. Candler</i>	

APPLICATION OF THE PSEUDO-TIME ACCURATE FORMULATION OF THE ADJOINT TO OUTPUT-BASED ADAPTIVE MESH REFINEMENT.....	2300
<i>Emmett Padway, Dimitri J. Mavriplis</i>	

DISCRETIZATION ERROR ESTIMATION USING THE UNSTEADY ERROR TRANSPORT EQUATIONS	2337
<i>Hongyu Wang, Weicheng Xue, Christopher J. Roy</i>	

VORTEX DYNAMICS III

A BRIEF SURVEY OF VORTEX MODELS	2351
<i>Aaron D. Kuenn, Linda K. Kliment</i>	
CHARACTERIZATION OF THE FLOW PAST THE FASTBACK DRIVER AUTOMOTIVE MODEL USING UNSTEADY SIMULATIONS	2362
<i>Matthew T. Aultman, Rodrigo Auza-Gutierrez, Zhenyu Wang, Lian Duan</i>	
HEAT TRANSFER ENHANCEMENT AND VORTEX INTERACTION OF DELTA WINGLET VORTEX GENERATORS WITH SLOTS	2388
<i>Jeryo Lee, Giovanni Nino, Robert Breidenthal</i>	
SIMULATIONS OF VORTEX BREAKDOWN UNDERGOING HEAT ADDITION AND EXTRACTION	2399
<i>Xiao Zhang, Joseph D. Chung, Carolyn R. Kaplan, Elaine S. Oran</i>	

MODELING AND CONTROL OF FLUID FLOWS

NONLINEAR FILTERING FOR SIMULTANEOUS STATE CORRECTION AND EDDY VISCOSITY ESTIMATION IN COMPUTATIONAL FLUID DYNAMICS.....	2409
<i>Shady E. Ahmed, Omer San, Imraan Faruque</i>	
GENERALIZED CLUSTER-BASED NETWORK MODEL FOR AN ACTUATED TURBULENT BOUNDARY LAYER.....	2420
<i>Daniel Fernex, Richard Semaan, Bernd Noack</i>	
AIRFOIL VORTEX SHEDDING NOISE REDUCTION VIA EXTREMUM-SEEKING CONTROL WITH MOVING ACTUATION	2436
<i>Tarcísio D. Oliveira, William Wolf</i>	
MECHANISM OF FLOW SEPARATION CONTROL WITH DBD PLASMA ACTUATOR OBTAINED BY APE X DEEP Q NETWORK CONTROL	2447
<i>Satoshi Shimomura, Satoshi Sekimoto, Akira Oyama, Kozo Fujii, Hiroyuki Nishida</i>	
MODELING THE DYNAMICS OF ACTUATION ON AN AIRFOIL AT POST-STALL ANGLES OF ATTACK	2456
<i>Katherine J. Asztalos, Scott T. Dawson, David R. Williams</i>	

RANS/LES/HYBRID TURBULENCE MODELING AND APPLICATIONS I

WALL-MODELED LES OF FLOW OVER A GAUSSIAN BUMP	2474
<i>Prahladh S. Iyer, Mujeeb R. Malik</i>	
TRANSONIC LIFT AND DRAG PREDICTIONS USING WALL-MODELLED LARGE EDDY SIMULATIONS	2492
<i>Aditya S. Ghate, Gaetan K. Kenway, Gerrit-Daniel Stich, Oliver M. Browne, Jeffrey A. Housman, Cetin C. Kiris</i>	

HYBRID RANS-LES PERIODIC HILL FLOW SIMULATIONS UP TO EXTREME REYNOLDS NUMBERS	2515
<i>Stefan Heinz, Reza Mokhtarpoor, Michael K. Stoellinger</i>	

CFD APPLICATIONS II

NUMERICAL STUDY OF FLOW STRUCTURES OF UNDERWATER SUPERSONIC JETS.....	2527
<i>Amartya Jana, Mahesh M. Sucheendran</i>	
A PENALIZATION METHOD FOR EULERIAN DROPLET IMPINGEMENT SIMULATIONS TOWARDS ICING APPLICATIONS.....	2543
<i>Pierre Lavoie, Emmanuel Radenac, Ghislain Blanchard, Eric Laurendeau, Philippe Villedieu</i>	
FLUID BEHAVIOR IN STOCHASTIC POROUS STRUCTURES.....	2562
<i>Michel Ho, Mujan Seif, Sean McDaniel, Sebastien Leclaire, Marcelo Reggio, Jean-Yves Trépanier, Matthew Beck, Alexandre Martin</i>	
ENTROPY STABLE SPLIT FORMS FOR THE FLUX RECONSTRUCTION HIGH-ORDER METHOD: NUMERICAL VALIDATION	2575
<i>Alexander Cichino, Sivakumaran Nadarajah</i>	

TURBULENT FLOWS I

A PRELIMINARY STUDY OF ROUGHNESS EFFECTS ON A COMPRESSIBLE TURBULENT BOUNDARY LAYER.....	2583
<i>Jonathan Gaskins, Jonathan Poggie, Gregory A. Blaisdell</i>	
COMPRESSIBILITY EFFECTS ON HOMOGENEOUS ISOTROPIC TURBULENCE USING SCHUR DECOMPOSITION OF THE VELOCITY GRADIENT TENSOR.....	2597
<i>Radouan Boukharfane, Aimad Er-Raiy, Matteo Parsani</i>	
MULTIPHYSICS COMPUTATIONAL ANALYSIS OF A PERFORATED PLATE COOLING FLOW.....	2615
<i>Justin M. Pesich, Nicholas J. Georgiadis, Mark P. Wernet</i>	

FLOW CONTROL FOR WING APPLICATIONS

AERODYNAMICALLY-ADAPTIVE AERO-STRUCTURES PART 1: FLOW-INTERACTIVE CONTROL USING DISTRIBUTED BLEED ACTUATION.....	2634
<i>Gabriel Peyredieu Du Charlat, Luca De Beni, Massimo Ruzzene, Ari Glezer</i>	
AERODYNAMICALLY-ADAPTIVE AERO-STRUCTURES PART 2: AERODYNAMIC-STRUCTURAL ANALYSIS	2649
<i>Luca De Beni, Gabriel Peyredieu Du Charlat, Ari Glezer, Massimo Ruzzene</i>	
CONTROL OF DYNAMIC TIP STALL ON SWEEPED WINGS	2665
<i>Daniel J. Garmann, Miguel Visbal</i>	
DELAY OF STALL FOR A STATIONARY WING PLACED IN A WAKE.....	2683
<i>Zhehong Zhang, Zhijin Wang, Ismet Gursul</i>	

BOUNDARY LAYER FLOW CONTROL

EXPERIMENTAL INVESTIGATIONS OF BOUNDARY LAYER TRANSITION ON A FLAT PLATE WITH SUCTION.....	2700
<i>Michelangelo Corelli Grappadelli, Stephan Sattler, Peter Scholz, Rolf Radespiel, Camli Badrya</i>	
NUMERICAL SIMULATION OF TRANSITION DELAY ON A WING SECTION BY DYNAMIC SURFACE DEFORMATION	2723
<i>Donald P. Rizzetta, Miguel Visbal</i>	
INITIAL COMPUTATIONAL INVESTIGATION TOWARD PASSIVE TRANSITION DELAY USING A PHONONIC SUBSURFACE.....	2746
<i>Caleb J. Barnes, Carson L. Willey, Kevin Rosenberg, Albert Medina, Abigail T. Juhl</i>	
TURBULENT BOUNDARY LAYER RESPONSE TO ACTIVE CONTROL ACTUATOR.....	2769
<i>Mitchell E. Lozier, Flint O. Thomas, Stanislav Gordeyev</i>	

RANS/LES/HYBRID TURBULENCE MODELING AND APPLICATIONS II

NUMERICAL MODELING OF DUST TRANSPORT AROUND MOVING VEHICLES IN UNSTEADY ATMOSPHERIC BOUNDARY LAYER USING PRECURSOR SIMULATION.....	2788
<i>Xiaoling Tong</i>	
RANS MODELLING OF A HIGH-TEMPERATURE JET IN A COLD CROSSFLOW: FROM EDDY VISCOSITY MODELS TO ADVANCED ANISOTROPIC APPROACHES	2798
<i>Romain Paysant, Emmanuel Laroche, Pierre Millan, Pierre Buet</i>	
COMPARISON OF HYBRID RANS/LES MODELS FOR ROCKET COMBUSTION CHAMBER SIMULATIONS	2810
<i>Timo Seitz, Peter M. Gerlinger</i>	
SIMULATION OF TURBULENT HYPERSONIC FLOW OVER A COLD WALL FLAT PLATE USING LARGE EDDY SIMULATION.....	2828
<i>Nadia Kianvashrad, Doyle D. Knight</i>	

STABILITY AND TRANSITION OVER AIRFOILS

LIFT CELL PREDICTION USING A LIFTING-SURFACE MODEL	2847
<i>Frédéric Plante, Eric Laurendeau, Julien Dandois</i>	
GROWTH OF TOLLMIE-SCHLICHTING WAVES ON AIRFOILS WITH SURFACE ROUGHNESS.....	2868
<i>Matthew S. Kuester</i>	
CONTROL OF T-SWAVES ON A NATURAL LAMINAR FLOW AIRFOIL USING DYNAMIC SURFACE MODIFICATION.....	2881
<i>John Wylie, Di Zhao, Sandipan Mishra, Michael Amitay</i>	

CFD APPLICATIONS III

ON THE STRUCTURE OF CORRECTION MATRICES FOR A K-EXACT HIGH-ORDER
FINITE-VOLUME SCHEME ON VERTEX-CENTERED UNSTRUCTURED GRIDS 2901
Florian Setzwein, Moritz Spraul, Peter Ess, Peter M. Gerlinger

UNSTEADY FLOW SIMULATION USING THE IMMERSSED BOUNDARY METHOD ON
THE CARTESIAN GRID WITH MOVING GRID TECHNIQUE 2914
Keisuke Sugaya, Taro Imamura

VOLUME 5

ALGEBRAIC SHARP INTERFACE CAPTURING FOR NON-EQUILIBRIUM MULTI-
MATERIAL FLOWS 2928
Aditya Pandare, Jacob Waltz, Jozsef Bakosi

SPECIAL SESSION: HIGH-FIDELITY CFD PREWORKSHOP

HIGH-FIDELITY CFD WORKSHOP 2022: MESH MOTION 2944
Per-Olof Persson, Krzysztof Fidkowski, Nathan A. Wukie

VERIFICATION TEST SUITE FOR SPALART-ALLMARAS QCR2000 TURBULENCE
MODEL 2956
*Boris Diskin, Nashat N. Ahmad, William K. Anderson, Joseph M. Derlaga, Mohagna J.
Pandya, Christopher L. Rumsey, Li Wang, Stephen L. Wood, Yi Liu, Hiroaki Nishikawa,
Marshall C. Galbraith*

WALL-MODELED LARGE-EDDY SIMULATION AND RANS FOR WORKSHOP ON
SMOOTH-BODY SEPARATION 2991
Michael C. Adler, Logan P. Riley, David R. Gonzalez, Sanjiva K. Lele

TURBULENT FLOWS II

DYNAMICS AND UNSTEADY FEATURES OF THE TURBULENT SEPARATION OVER A
FORWARD-FACING STEP 3009
Christopher J. Schauerte, Anne-Marie Schreyer

TEMPERATURE AND FLOW MEASUREMENTS IN INCOMPRESSIBLE HEATED JETS 3032
Puja Upadhyay, Khairul Q. Zaman

FLOW CONTROL FOR PROPULSION APPLICATIONS

STEADY AND UNSTEADY CONTROL OF NACELLE INLET FLOW IN CROSSWIND 3049
Derek A. Nichols, Bojan Vukasinovic, Ari Glezer, Matthew C. Defore, Bradley Rafferty

TOWARD A PASSIVE CONTROL STRATEGY FOR A SUPERSONIC MULTI-STREAM
FLOW USING RESOLVENT ANALYSIS 3064
*Parshwanath S. Doshi, Rajesh Ranjan, Qiong Liu, Emma D. Gist, Datta V. Gaitonde, Mark
N. Glauser*

SPECTRAL STUDY OF WALL PRESSURE MEASUREMENTS IN AN IMPINGING SHOCK-WAVE BOUNDARY LAYER INTERACTION.....	3081
<i>Amruthkiran Hegde, Narendra Changanti, James P. Hubner, Semih M. Olcmen</i>	
EFFECTS OF GEOMETRIC MODIFICATIONS ON A COMPLEX MULTI-STREAM SUPERSONIC RECTANGULAR NOZZLE.....	3094
<i>Emma D. Gist, Seth Kelly, Tyler Vartabedian, Rishov Chatterjee, Parshwanath S. Doshi, Mark N. Glauser, Datta V. Gaitonde</i>	
STUDY OF AXIAL GROOVE CASING TREATMENT FOR CO-FLOW JET MICRO-COMPRESSOR ACTUATORS.....	3105
<i>Kewei Xu, Gecheng Zha</i>	

BOUNDARY LAYER TRANSITION I

THREE-DIMENSIONAL SPATIO-TEMPORAL DISTURBANCE FLOW FIELD ANALYSIS OF PARTICULATE-INDUCED HIGH-SPEED BOUNDARY-LAYER TRANSITION	3120
<i>Sayed Mohammad Abdullah Al Hasnine, Vincenzo Russo, Anatoli Tumin, Christoph Brehm</i>	
DIRECT NUMERICAL SIMULATIONS OF LAMINAR-TURBULENT TRANSITION FOR TRANSONIC BOUNDARY LAYERS	3141
<i>Christoph Hader, Ning Deng, Michael Woodward, Hermann F. Fasel</i>	
SLIP EFFECTS ON THE STABILITY OF SUPERSONIC LAMINAR FLAT PLATE BOUNDARY LAYER	3153
<i>Angelos Klothakis, Saurabh S. Sawant, Helio Quintanilha, Vassilios Theofilis, Deborah A. Levin</i>	

CFD APPLICATIONS IV

ONGOING DEVELOPMENT OF NON-REFLECTIVE BOUNDARY CONDITIONS FOR EULER AND NAVIER-STOKES EQUATIONS VIA THE DISCONTINUOUS GALERKIN FRAMEWORK.....	3181
<i>Edmond Shehadi, Edwin Van Der Weide</i>	
AERODYNAMIC ANALYSIS OF MULTI-PROPELLER/WING INTERACTION USING THE ACTUATOR SURFACE MODEL	3200
<i>Shaka Chu, Daniel Linton, Dries Verstraete, Ben Thornber</i>	
ENTROPY STABLE NO-SLIP WALL BOUNDARY CONDITIONS FOR THE EULERIAN MODEL FOR VISCOUS AND HEAT CONDUCTING COMPRESSIBLE FLOWS.....	3215
<i>Mohammed Sayyari, Lisandro Dalcin, Matteo Parsani</i>	
EVALUATION OF THE SINGLE-POPULATION LATTICE BOLTZMANN METHOD FOR ONE-DIMENSIONAL COMPRESSIBLE FLOWS.....	3228
<i>Samuel J. Mitchell, Sina Stapelfeldt, Ricardo Puente</i>	

RANS/LES/HYBRID TURBULENCE MODELING AND APPLICATIONS III

DEVELOPMENT AND VALIDATION OF AN ELLIPTIC BLENDING LAG WALL-DISTANCE-FREE SST K- ω TURBULENCE MODEL	3244
<i>Wenjie Shang, Ramesh K. Agarwal</i>	

OPTIMAL CLIPPING OF THE GRADIENT MODEL FOR SUBGRID STRESS CLOSURE..... 3261
Aviral Prakash, Kenneth E. Jansen, John A. Evans

EVALUATION OF RANS CLOSURE MODELS USING LES DATASETS FOR HYPERSONIC SHOCK BOUNDARY LAYER INTERACTIONS..... 3277
Cyrus Jordan, Jack R. Edwards, Douglas L. Stefanski

BALANCING ACCURACY AND EFFICIENCY IN THE AUTONOMIC CLOSURE METHODOLOGY FOR LARGE EDDY SIMULATIONS 3299
Abhinav Kshitij, Eric W. Stallcup, Colin A. Towery, Peter E. Hamlington, Werner J. Dahm

TURBULENT FLOWS III

HIGH-FIDELITY NUMERICAL SIMULATIONS OF SUPERSONIC CHANNEL FLOWS WITH ISOTHERMAL WALLS 3324
Luiz Augusto C. Schiavo, William Wolf, Britton J. Olson, Joao Luiz F. Azevedo

DNS/LES OF SUPERSONIC TURBULENT BOUNDARY LAYER USING COMPACT INTERPOLATION METHOD 3337
Shankar Ghosh, Badal Modi

CHARACTERIZATION OF SEPARATED FLOWFIELD OVER GAUSSIAN SPEED-BUMP CFD VALIDATION GEOMETRY 3350
Owen J. Williams, Madeline Samuell, Matthew L. Robbins, Hariprasad Annamalai, Antonino Ferrante

SIMULATION AND MODELING OF HYPERSONIC TURBULENT BOUNDARY LAYERS SUBJECT TO FAVORABLE PRESSURE GRADIENTS DUE TO STREAMLINE CURVATURE..... 3366
Gary Nicholson, Junji Huang, Lian Duan, Meelan M. Choudhari, Rodney D. Bowersox

MODAL ANALYSIS AND DEEP LEARNING FOR FLUID FLOWS I

AN APPROPRIATE WAKE REGION DETERMINATION FOR WAKE-INTEGRAL METHOD BY DEEP LEARNING 3394
Yuta Natsume, Daisuke Sasaki, Kisa Matsushima

ENTROPY-BASED MODAL DECOMPOSITIONS OF HIGH-SPEED, VORTEX-DOMINATED FLOWS 3417
Ethan Vogel, James G. Coder

CONVOLUTIONAL NEURAL NETWORKS FOR THE CONSTRUCTION OF SURROGATE MODELS OF FLUID FLOWS 3436
Hugo Lui, William Wolf

SPACE-TIME GALERKIN PROJECTION VIA SPECTRAL PROPER ORTHOGONAL DECOMPOSITION AND RESOLVENT MODES 3451
Aaron Towne

BOUNDARY LAYER TRANSITION II

DIRECT NUMERICAL SIMULATIONS OF NONLINEAR ENTROPY-LAYER INSTABILITY WAVES..... 3467
John A. Meersman, Christoph Hader, Hermann F. Fasel

TRANSITION TO TURBULENCE ON HYPERSONIC FLAT PLATES INDUCED BY STOCHASTIC FORCING	3483
<i>Hemanth Goparaju, Datta V. Gaitonde</i>	

DIRECT NUMERICAL SIMULATIONS OF THE NONLINEAR BOUNDARY LAYER TRANSITION REGIME ON A FLAT PLATE AT MACH 6.....	3501
<i>Madlen Leinemann, Christoph Hader, Hermann F. Fasel</i>	

CFD VERIFICATION AND VALIDATION

EXPERIMENTAL VALIDATION OF THE QUADRATIC CONSTITUTIVE RELATION IN SUPERSONIC STREAMWISE CORNER FLOWS	3521
<i>Kshitij Sabnis, Daniel Galbraith, Holger Babinsky, John A. Benek</i>	

FLOW FIELD FEATURES OF THE BEVERLI HILL MODEL.....	3545
<i>Aldo Gargiulo, Julie E. Duetsch-Patel, Thomas A. Ozoroski, Colton Beardsley, Vidya Vishwanathan, Danny Fritsch, Aurelien Borgoltz, William J. Devenport, Christopher J. Roy, Kevin T. Lowe</i>	

CODE VERIFICATION FOR 2D UNSTEADY FLOWS IN SENSEI	3567
<i>Weicheng Xue, Hongyu Wang, Christopher J. Roy</i>	

RANS/LES/HYBRID TURBULENCE MODELING AND APPLICATIONS IV

SIMULATING THE NASA JUNCTURE FLOW MODEL WITH A SCALE-RESOLVING LATTICE-BOLTZMANN METHOD	3582
<i>Benjamin M. Duda, Gregory M. Laskowski</i>	

ON RANS TURBULENCE MODELS FOR HIGH-SPEED APPLICATIONS.....	3597
<i>Axel Buck, Christian Mundt</i>	

TURBULENT FLOWS IV

WALL TEMPERATURE EFFECT ON HYPERSONIC TURBULENT BOUNDARY LAYERS VIA DNS.....	3608
<i>Guillermo Araya, Christian J. Lagares, Jean Santiago, Kenneth E. Jansen</i>	

UNSTRUCTURED LES_DNS OF A TURBULENT BOUNDARY LAYER OVER A GAUSSIAN BUMP.....	3622
<i>James R. Wright, Riccardo Balin, Kenneth E. Jansen, John A. Evans</i>	

MODAL ANALYSIS AND DEEP LEARNING FOR FLUID FLOWS II

MACHINE LEARNING BASED MODEL REDUCTION FOR FLUID-STRUCTURE INTERACTION	3638
<i>Vedang Patel, Srinivasan Parthasarathy, Vilas J. Shinde, Datta V. Gaitonde</i>	

VOLUME 6

ADAPTIVE REDUCED ORDER MODELLING FOR STEADY AERODYNAMICS FLOWS	3656
<i>Giuseppe Fortunato, Gaetano Pascarella, Marco Fossati, Gabriel Barrenechea</i>	

COMPARATIVE STUDY OF SEQUENTIAL DATA ASSIMILATION METHODS FOR THE KURAMOTO-SIVASHINSKY EQUATION.....	3672
<i>Suraj A. Pawar, Omer San</i>	

FEATURE SELECTION, CLUSTERING, AND PROTOTYPE PLACEMENT FOR TURBULENCE DATA SETS	3689
<i>Matthew F. Barone, Jaideep Ray, Stefan Domino</i>	

CFD APPLICATIONS V

A MATRIX-FREE GMRES ALGORITHM ON GPU CLUSTERS FOR IMPLICIT LARGE EDDY SIMULATION	3707
<i>Eduardo Jourdan De Araujo Jorge Filho, Zhi J. Wang</i>	

DEVELOPMENT OF COMPUTATIONAL FLUID DYNAMIC (CFD) MODELS OF THE FORMATION AND BUOYANCY-DRIVEN DETACHMENT OF BUBBLES IN VARIABLE GRAVITY ENVIRONMENTS.....	3723
<i>Paul A. Burke, Bonnie J. Dunbar</i>	

ACCURATE CFD MEASUREMENTS OF VORTEX GENERATORS EFFECTS ON A WING SUBJECT TO SHOCK-INDUCED SEPARATION	3744
<i>Marcello Ferrari, Kelvin C. Morais, Denise Ferrari, Otto C. De Resende, Luis Santos</i>	

UNSTRUCTURED ANISOTROPIC MESH ADAPTATION FOR QUADS BASED ON A LOCAL ERROR MODEL	3754
<i>Keigan Maclean, Sivakumaran Nadarajah</i>	

RANS/LES/HYBRID TURBULENCE MODELING AND APPLICATIONS V

WMLES OF BOUNDARY-LAYER TRANSITION.....	3769
<i>Stephen Woodruff</i>	

ERROR QUANTIFICATION AMONG CFD SOLVERS FOR HIGH-SPEED, NON-ADIABATIC, WALL-BOUNDED TURBULENT FLOWS.....	3787
<i>Syed Imthiaz Ahamed Syed Abid Hussain, Jean-Pierre Hickey, Bryan Godbolt, Ed Farnfield</i>	

HYBRID RANS/LES OF SUPERSONIC TURBULENT BOUNDARY LAYER USING COMPACT INTERPOLATION METHOD	3815
<i>Shankar Ghosh, Badal Modi</i>	

EVALUATION OF WALL MODELED LARGE EDDY SIMULATION OF COLD WALL HYPERSONIC BOUNDARY LAYER	3827
<i>Robyn L. Macdonald, Graham V. Candler</i>	

ASSESSMENT OF ZDES FOR WMLES OF TURBULENT BOUNDARY LAYERS WITH PRESSURE GRADIENT AND MILD FLOW SEPARATION	3840
<i>Jaime Vaquero, Nicolas Renard, Sébastien Deck</i>	

TURBULENT FLOWS V

SYNTHETIC FREESTREAM TURBULENCE GENERATION AT AN INFLOW BOUNDARY CONDITION.....	3851
<i>Gabriel B. Goodwin, Christian L. Bachman, Ryan F. Johnson, David A. Kessler</i>	

AIRFOIL NEAR WAKE TURBULENT PROPERTIES AT MAXIMUM AERODYNAMIC EFFICIENCY CONDITION 3869
Sidaard Gunasekaran, Rachel Sharp

STUDY ON COHERENT STRUCTURES FOR HIGH TURBULENCE BURNER 3882
Alberto Ceschin, Lorenzo Angelilli, Francisco E. Hernandez Perez, Isaac G. Boxx, Hong G. Im

MODAL ANALYSIS AND DEEP LEARNING FOR FLUID FLOWS III

CONSTRUCTION OF NONLINEAR DYNAMIC EQUATIONS FROM DATA USING LEAST ANGLE REGRESSION WITH AN ORTHOGONALIZATION STEP 3891
John Graff, Francis D. Lagor

SPARSE BIORTHOGONAL DECOMPOSITION 3902
Charles E. Tinney

BOUNDARY LAYER TRANSITION III

INFLUENCE OF BOUNDARY LAYER TRANSITION ON THE AERODYNAMICS OF A SLICED CONE WITH RAMP AT MACH 6 3920
Maheck J. Terceros, Daniel Araya

DESIGN OF A MACH 5 FLARED CONE FOR FIRST-, SECOND-MODE MECHANISMS INTERACTIONS 3932
Tony Liang, Arham A. Khan, Joseph Kuehl

CRITICAL ROUGHNESS HEIGHTS OF TURBULENT TRANSITION ON A SWEEPED LAMINAR-FLOW WING 3945
Ryota Sakakibara, Tomohiro Nimura, Takahiro Tsukahara, Takahiro Ishida

WING-GUST INTERACTION I

INTERACTION OF QUASI-TWO-DIMENSIONAL VORTICAL GUSTS WITH SWEEPED AND UNSWEEPED WINGS 3957
Yuanzhi Qian, Zhijin Wang, Ismet Gursul

APPLICATIONS OF ENSEMBLE KALMAN FILTERED VORTEX MODELING TO GUST--WING INTERACTIONS 3979
Jeff Eldredge, Mathieu Le Provost, Ricardo Baptista, Youssef Marzouk

A LOW-RANK NONLINEAR ENSEMBLE FILTER FOR VORTEX MODELS OF AERODYNAMIC FLOWS 3986
Mathieu Le Provost, Ricardo Baptista, Youssef Marzouk, Jeff Eldredge

GENERATING TRAVELING CROSS-FLOW GUSTS IN A WIND TUNNEL 4013
Xiaowei He, Katherine J. Asztalos, James Henry, Scott T. Dawson, David R. Williams

CFD APPLICATIONS VI

HIGH-ORDER DISCONTINUOUS GALERKIN DIFFERENCE CUT-CELL DISCRETIZATION 4028
Sharanjeet Kaur, Jason E. Hicken

LARGE EDDY SIMULATION OF WINGTIP VORTEX EVOLUTION IN AN ADVERSE PRESSURE GRADIENT	4041
<i>Elizabeth Wood-Bowyer, Alastair West, Joel Ho Mun Onn, Chris Cantwell</i>	

FLOW CONTROL FOR FLIGHT

INFLUENCE OF COANDA BLANKET CURVATURE ON COANDA MAV LIFT GENERATION PERFORMANCE	4060
<i>Mohamad Arif A. Siswantara, Ratih Julistina, Harijono Djodihardjo</i>	
FLIGHT CONTROL OF AN OGIVE CYLINDER WITH OFF-AXIS LASER DISCHARGE	4076
<i>Yashesh Sakharikar, Arastou Pournadali Khamseh, Edward P. Demauro, Doyle D. Knight</i>	
FLIGHT TEST OF UAV WITH DBD-PA FLOW CONTROL	4094
<i>Hiroshi Yoneda, Azusa Goto, Hiroki Kato, Satoshi Sekimoto, Kozo Fujii</i>	
CONTROLLED AERODYNAMIC LOADS ON A SLENDER AXISYMMETRIC BODY AT HIGH INCIDENCE.....	4110
<i>Edward Lee, You Huang, Bojan Vukasinovic, Ari Glezer</i>	
FLOW-CONTROL EXPERIMENT AROUND HALF-SPAN WING MODEL FOR DBD-PA APPLICATION ON UAV	4129
<i>Satoshi Sekimoto, Koji Fujita, Kozo Fujii</i>	

TURBULENT FLOWS VI

LES SCALE ENRICHMENT AND ITS EFFECT ON THE PRESSURE FIELD	4143
<i>Ryan Hass, Aditya S. Ghate, Sanjiva K. Lele</i>	
THE SPACE-TIME CORRELATION OF PRESSURE UNDER HIGH REYNOLDS NUMBER SMOOTH WALL TURBULENT BOUNDARY LAYERS IN PRESSURE GRADIENT FAMILY	4153
<i>Danny Fritsch, Vidya Vishwanathan, Kevin T. Lowe, William J. Devenport</i>	
LES OF COMPRESSION RAMP USING HIGH-ORDER DYNAMIC SGS MODELING	4168
<i>Niccolò Tonicello, Guido Lodato, Luc Vervisch</i>	
LAMINAR TO TURBULENCE TRANSITION IN BOUNDARY LAYERS DUE TO TRIPPING DEVICES	4185
<i>Ponnampalam Balakumar, Prahladh S. Iyer</i>	
EDDY VISCOSITY MODELLING AROUND CURVED BOUNDARIES.....	4202
<i>Toh Yi Han, Mohamed Arif Mohamed, Bing Feng Ng</i>	

WING-GUST INTERACTION II

UNSTEADY MODELLING OF PITCHING WINGS FOR GUST MITIGATION	4212
<i>Ignacio Andreu Angulo, Holger Babinsky</i>	
LIFT REGULATION USING CLOSED-LOOP FEEDBACK AND CONTROL	4229
<i>Michael P. Mongin, Sidaard Gunasekaran</i>	
NUMERICAL MODELLING OF AERODYNAMIC RESPONSE TO GUST	4240
<i>Weixing Yuan, Xiaoyang Zhang, Dominique Poirel</i>	

ACTUATION TECHNOLOGY FOR FLOW CONTROL

RECOMMENDED PRACTICES FOR CHARACTERIZATION AND DOCUMENTATION OF ACTIVE FLOW CONTROL ACTUATORS	4259
<i>Rene Woszidlo, Jesse C. Little</i>	
EXPERIMENTAL INVESTIGATION OF SYNCHRONIZED SWEEPING JETS FOR FILM COOLING APPLICATION.....	4274
<i>Alex Spens, Jeffrey P. Bons</i>	
CONTROL OF FLOW SEPARATION OVER A CURVED SURFACE USING FLUIDIC ACTUATOR ARRAYS WITH VARIABLE SPANWISE PERIODICITY	4289
<i>Curtis J. Peterson, Bojan Vukasinovic, Marilyn J. Smith, Ari Glezer</i>	
THE ROLE OF AMPLITUDE ON CONTROLLING FLOW SEPARATION USING TRAVELING WAVE MORPHING	4306
<i>Amir Akbarzadeh, Iman Borazjani, Uchenna Ogunka</i>	

CFD APPLICATIONS VII

NUMERICAL INVESTIGATION OF LOW-PRESSURE TURBINE CASCADE WITH UNSTEADY WAKES	4321
<i>Zachary D. Robison, Andreas Gross</i>	
VALIDATION OF THREE-DIMENSIONAL GRID REFINEMENT FOR EFFICIENT RESOLUTION OF LATTICE BOLTZMANN METHOD	4356
<i>Zhishang Xu, Sina C. Stapelfeldt, R. Puente</i>	
A COMPRESSIBLE LES WITH IMMERSED BOUNDARY METHOD.....	4371
<i>Amir Akbarzadeh, Iman Borazjani</i>	
NUMERICAL SIMULATIONS OF FLOW PAST A THREE-CYLINDER ROTATING SYSTEM USING SCALE ADAPTIVE SIMULATION (SAS).....	4383
<i>Nick L. Thomas, Al Habib Ullah, Yildirim B. Suzen, Jordi Estevadeordal</i>	

Author Index